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Making the Connection

Beneficial Collaboration Between Army Installations and Energy Utility Companies

Beth E. Lachman, Kimberly Curry Hall,
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Preface

Awareness of energy use and concern over long-term supply are increasing in the United States and with them the demand for ways to reduce energy consumption and to get more energy from renewable sources. Congress has passed significant legislation and regulations in recent years that have established benchmarks and guidelines for energy efficiency and renewable energy implementation. Army installations consume substantial amounts of energy, and the Army is seeking ways to meet these federal energy requirements, conserve resources, and save costs. In research sponsored by the U.S. Army's Assistant Chief of Staff for Installation Management, RAND Arroyo Center researched ways that the Army could improve collaboration with utility companies to reduce energy consumption and help meet other Army energy goals. This document reports the results of that research.

This report should be of interest to military energy policymakers and managers as well as those in other federal agencies and utilities. Other organizations, such as state and local governments and nongovernmental organizations that are interested in utility collaboration, decreasing energy consumption, renewable energy investments, energy security, and other energy management topics, should also find it of interest.

This research has been conducted in RAND Arroyo Center's Military Logistics Program. RAND Arroyo Center, part of the RAND Corporation, is the Army's federally funded research and development center for policy studies and analysis. Questions and comments regarding this research are welcome and should be directed to the project leader, Beth Lachman, at bethl@rand.org.

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Summary

The Army owns and operates installations across the globe, and these installations consume substantial amounts of energy. The Army wants to reduce its energy consumption for several reasons. First, it is under legislative mandate to do so. The Energy Independence and Security Act (EISA) of 2007 directs military installations to reduce their energy consumption 30 percent by 2015, and the Energy Policy Act of 2005 (EPAct) directs them to increase, by 7.5 percent, their use of energy from renewable sources by 2013.¹ The Army also faces regulatory pressure. Issued in October 2009, Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” directs federal agencies, including the Army, to increase energy efficiency and measure, report, and reduce their greenhouse gas emissions. Additionally, the Army would like to lower its energy costs: the cost of Army installation energy utilities was over \$1.2 billion in 2010.² To help meet such goals in fall 2010, the Army announced a new Army energy vision for the Net Zero Energy Installation (NZEI), an installation that over the course of a year produces as much energy on site as it uses, in April 2011 announcing pilot installations that are trying to become NZEIs by 2020.³

While the Army has an active energy program to meet these federal energy requirements, conserve resources, and save costs, installations have limited investment options for programs that help achieve energy goals, even those with a net financial benefit. Neither do they have any dedicated funding for energy efficiency or renewable energy projects. One way to reduce energy consumption, lower costs, help meet energy security, NZEIs and other energy goals, and fund projects is for Army installations to collaborate with utility companies, and they have a number of ways to do that. An installation can partner with a utility in a Utility Energy Service Contract (UESC), which is a partnership between the installation and a utility in which the utility pays

¹ U.S. Library of Congress (U.S. LOC), “H.R.6 Energy Independence and Security Act of 2007,” 2007.

² Personal communication with ACSIM staff, August 4, 2011. Note that this statistic does not include any transportation energy, just the installation energy utilities.

³ For more information, see OASA (Installations, Energy and Environment), “Net Zero Installations Identified,” no date.

for the upfront costs of energy efficiency projects and the installation pays this money back from its energy savings.

This Project

The Assistant Chief of Staff for Installation Management, Headquarters, U.S. Army asked RAND Arroyo Center to recommend ways that the Army's installations could improve collaboration with utility companies to reduce energy consumption and help meet other Army energy goals. The project had four tasks:

- Examine how Army installations currently collaborate with utility companies.
- Identify problems with, or barriers to, such collaboration.
- Identify and assess options for improving collaboration.
- Recommend ways the installations and utilities could improve collaboration.

How Army Installations Currently Collaborate with Utility Companies

Installations have a number of options for how they can collaborate with utility companies. Not all of the options listed below are available in all locations. Generally, in states with strong public utility commissions and a mandate to reduce energy consumption, more options are available. Collaboration can offer mutual benefits. For the installation, it can help reduce energy consumption and save money, tap into a source of expertise and advice, and fund energy projects that would be difficult to finance through traditional sources. Such collaborations help installations meet their energy conservation, energy security, renewable energy, and other energy goals and requirements. We found that some installations and utilities form close long-term partnerships working together on a range of installation energy efficiency and management tasks. For the utility company, good collaboration can help its bottom line, whether by increasing profits or improving its public image. Furthermore, collaboration can reduce demand, obviating or delaying the need to provide additional capacity. It can also help utilities meet their energy conservation, renewable energy, and other goals.

Utility Energy Service Contracts (UESCs) Collaboration

UESCs provide a way to help finance and implement energy efficiency projects at installations. Projects include replacing interior and exterior lighting with more efficient lighting, replacing old electric motors with high-efficiency models, replacing fans and pumps, installing occupancy sensors that turn lights off when rooms are not occupied, installing solar hot water heaters, and so forth. The utility provides the initial

investment, and the installation pays it back over the life of the contract, usually ten years.

Utility Service Contracts (USCs)

Installations can also use USCs, which provide energy-related upgrades that may or may not produce energy savings, such as building utility distribution and transmission systems on the installation. USCs can also be used by installations to make sole-source contracts for efficiency projects. In one example, they were used in this way for solar power street and parking lot lighting.

Collaboration in Energy Security and Reliable Service

Most utilities work closely with their Army installation customers to ensure that they have reliable power. Many utilities also work closely with installation staff when they need to shut off power temporarily because of routine maintenance work so that they can minimize disruptions to the installation's operations. Utilities can also help installations ensure that they have energy security. They may work with an installation on planning for backup power in the event of an emergency. To gain energy security benefits, installations may also allow an on-site power generation plant, as several Air Force bases (AFBs) have done.

Energy Audits, Technical and Other Assistance

Utilities often provide free or fee-based energy audits, in which utility company representatives review individual buildings or groups of buildings and facilities at an installation to identify potential energy efficiency projects. Often these audits examine a large number of buildings and facilities and identify a range of energy efficiency projects. Sometimes they also include water conservation projects.

Utilities can also provide a range of technical assistance for their installation customers, and some become trusted advisors and true partners in improving installation energy management and efficiency. Utility companies sometimes provide free or fee-based assistance for reviewing, identifying, choosing, installing, or operating energy efficient and renewable energy technologies. Sometimes such technical assistance includes studies and installation of the actual technology. Assistance can even include legal, regulatory, and financial advice on project implementation and even Energy Savings Performance Contracts (ESPCs).

Training and Education

Some utilities also offer free energy efficiency and technology training and education. Utilities that are more strongly motivated to save energy offer a wider range of classes and have a wider range of expertise to help their customers reduce energy consumption and improve their energy efficiency and management programs.

Collaboration in Renewable Energy

Installations also collaborate with utilities in exploring, investing in, and operating renewable energy projects and renewable energy credits (RECs). Since many renewable energy technologies are newer and less tested, they often require research, testing, and analysis before they can be installed, especially larger-scale projects. Utilities can and have helped in this process. Utilities also can play an important role in helping to finance, negotiate, and even build and operate on-site renewable energy generation projects. Installations have an interest in allowing on-site renewable energy generation to help meet their renewable energy and energy security goals.

Providing Energy Staff

Utilities may even provide or help pay for experienced energy staff to work at an Army installation. A few years ago, Southern California Edison (SCE) and the Army split the cost of Fort Irwin's resident Resource Efficiency Manager (REM).⁴ However, he spent three days a week at Fort Irwin and only two days helping SCE, which was a good deal for the installation. Fort Irwin benefited by having a trained and experienced energy expert on staff who also brought important lessons and experience from the two days he spent working for SCE at other locations.

Utility Rebate and Incentive Programs

Some utilities offer or promote state rebate programs and incentives to motivate their customers to invest in energy efficient and renewable energy technologies. Utilities often want to help their customers save energy so they do not have to build new power generation facilities. In addition, such programs are being implemented because of state regulations, incentives, and public utility commission (PUC) requirements to help save energy and invest in renewable energies, such as solar credits in California.

Demand Response

Utilities like to work with installations in "demand response" programs because they tend to be large users of electricity. In such programs, a customer agrees to short periods of decreased electrical consumption, generally determined and controlled by the utility, because of short-term grid stresses and in exchange for incentive payments.

There are two main program types: (1) reliability-based, which occurs in an emergency situation when the electricity demand is high and about to exceed existing capacity, creating the risk of a brown-out, and (2) price-based, i.e., economic, to reduce demand at high peak times when load is high.

⁴ REMs serve as contractors who work for the government and are effectively paid by the Army through a contracting mechanism, such as a UESC, generally with self-generated energy-related savings as stipulated in the contract.

Barriers That Impede Collaboration

In spite of the fact that collaboration benefits both the utility company and the installation, there are barriers that limit such cooperation.

Lack of Interest at the Utility Company

Some utility companies are simply not interested in participating in UESCs and other collaboration projects for a variety of reasons, including lack of interest and knowledge, lack of staff, lack of technical expertise, perception of risk in working with military installations, and perceived slow government bureaucracy. For example, utility companies tend to be risk averse, and some see UESCs with the military as too risky. They have the same issue in collaborating on some renewable energy projects.

Lack of Experienced Energy Staff at Installations

The most significant barrier that we identified was the lack of a qualified and experienced full-time energy manager. The highest personnel level for energy-related installation positions is a GS-12 or equivalent in the new federal government personnel rating system. The lack of room for advancement in the energy field beyond this level is thought to contribute to a relatively high turnover rate of installation energy managers. When an experienced energy manager leaves, often a junior person comes on board, and the Army loses important energy expertise.

Even when there is a full-time energy manager at an installation, there is often not enough other trained energy staff to support him or her. Energy managers have many responsibilities and need additional qualified energy staff to meet installation energy requirements, especially at larger installations.

Additionally, installation energy staff frequently lack the technical expertise or business experience required to implement a UESC and large-scale renewable energy projects. Energy staff are also often not aware of the ways in which utility companies can help them.

Legal and Contracting Staff Issues

The second most significant barrier to collaboration stems from legal and contracting staff issues. Interviews done for this project revealed that legal and contracting staff reluctance to participate in a UESC process can delay a project for months or years, which can completely halt the effort. This reluctance results from a lack of understanding of and familiarity with UESCs. Staff availability also affects the willingness to pursue such contracts. The legal and contracting staff have a full slate of activities, and UESCs must compete with these.

Other Installation Support Issues

Other installation support concerns also act as barriers impeding utility and installation collaboration. First, Departments of Public Works (DPWs) often lack the time or qualified staff to work with utilities and the installation energy staff on collaborative UESCs and other projects. Second, installation commanders frequently do not support—or lack interest in—utility collaboration. This support is often needed to ensure that all relevant installation staff endorse the UESC process or other collaborative effort. Finally, financial and business installation staff are sometimes not interested in UESCs due to a reluctance to make a long-term commitment and to cope with the financial complexities of implementing a UESC.

Renewable Energy Investment Issues

In addition to barriers to energy efficiency projects more generally, there are barriers specific to renewable energy projects. Some barriers are economic. Low utility rates can make renewable energy projects seem like a less attractive financial investment. Also, renewable energy technologies carry more uncertainty and risk than other approaches do. Because these technologies are not as established as those used in more traditional energy efficiency projects, installation personnel may not feel comfortable taking them on, especially given the level of technical expertise needed to assess project details. The availability and reliability of renewable energy resources also pose some concern. Finally, the ten-year payback of a UESC often limits renewable energy collaboration, because renewable energy projects take a longer period of time to show significant savings.

Other Barriers to Successful UESC Implementation

Additional issues that limit successful UESC implementation include measurement and verification (M&V) and operations and maintenance (O&M) issues. Without proper M&V and O&M, UESC (and ESPC) projects will not achieve expected energy savings. If a project does not achieve the expected energy savings or at least get close to it, the project is not successful and can cost the Army a large amount of money without getting much of the anticipated benefit. Lack of building commissioning (a systematic, quality assurance process) is also another issue with respect to achieving energy savings.

Other Impediments to Installation and Utility Collaboration

These issues are other collaboration opportunities where there has been less activity by Army installations but that hold great potential for utility and installation collaboration. The first issue is that there is a lack of knowledge about or interest in other non-UESC collaboration funding mechanisms, such as power purchase agreements (PPAs) and USCs, which could serve as alternative or complementary funding vehicles to UESCs for energy projects at installations. Energy security and on-site power genera-

tion are other areas where both installations and utilities have interests in collaborating more. As is the case with other collaboration possibilities, the main barriers here include lack of interest, information, knowledge, and time by both installation and utility staff to pursue such arrangements.

Metering and smart-grid collaboration are other areas of mutual interest. Many utilities want to help installations install meters because it is so important to their business. Utilities have expertise in metering and ways to help installations install meters despite budget problems, but installations are not aware of such opportunities. Utilities also want installations to start thinking about smart grids, which would include monitoring systems that keep track of all electricity flowing in the system.

Lastly, utilities would like installations to participate more in their demand response and other incentive programs. But military installation participation has been low because it can be difficult for installations to receive the proceeds from the demand response participation.

Recommendations to Overcome Barriers

We provide many recommendations on ways to overcome barriers that impede collaboration with utility companies. Some involve providing additional resources. However, the Army can go a long way toward solving the collaboration issue by implementing five recommendations that involve only modest resources. These are our highest-priority recommendations. They are as follows:

- Establish a full-time energy manager at each installation, ideally at least at the GS-13 level for the larger installations.⁵
- Develop and widely distribute a UESC policy and handbook.
- Expand installation staff training on UESC and utility collaboration.
- Provide more technical assistance to installations and utilities.
- Allow a longer payback period for UESCs, as long as 30 years or more, for greater flexibility.

These five recommendations help address multiple barriers.

Motivating Utilities to Collaborate with Installations

Ways to help motivate more utilities to collaborate with installations in UESCs and other projects fall into four main categories: (1) promote more direct outreach and

⁵ It is important to note that since this research was done, IMCOM has made it a priority to have a full-time trained Certified Energy Manager at each installation and has stated this as a specific task in the latest version of the installation community management campaign plan. See IMCOM, “The Installation Management Campaign Plan 2010–2017,” Version 3.0, April 2011, p. 41.

collaboration with utilities, (2) provide more education to utilities, (3) allow a longer payback period for UESCs, as long as 30 years or more, for greater flexibility, and (4) speed up the federal process where possible.

Promote outreach and collaboration with utilities. Collaboration would improve simply by having installations discuss their interest in UESCs and other collaboration with utilities. To further this effort, the Office of the Assistant Chief of Staff for Installation Management (ACSIM) and Installation Management Command (IMCOM) should have a policy that installations should engage more with their utilities. Installations are often a utility's largest customer. So an installation just expressing interest in a UESC can help start the process. Also, ACSIM, IMCOM, and other commands should engage more with utility associations to increase UESC awareness. Finally, ACSIM, IMCOM, and other commands should encourage a utility that is working successfully with an installation on UESCs to talk with a utility reluctant to collaborate. A success story from the perspective of another utility may be all it takes to get a reluctant one engaged in collaborating with its local installation.

Educate the utilities. ACSIM, IMCOM, and the other Army commands should also do more to provide education about UESCs to utilities by working with the Federal Energy Management Program (FEMP) and Pacific Northwest National Laboratory (PNNL) to help provide such education. One way utilities can become educated on UESCs is through FEMP outreach. If utility companies do not have technical staff to help facilitate UESCs, PNNL can provide technical assistance. PNNL can provide services such as recruiting utilities that have not participated in UESCs in the past, providing sample contract vehicles to help eliminate contracting hurdles, and evaluating the technical viability of a project. IMCOM has already hired PNNL to provide such UESC assistance to Army installations and their utilities. Installations have found this useful in educating utilities and encouraging them to do UESC projects. Such assistance should be continued. The Army should also develop a standard briefing that details the advantages that UESC participation provides to utilities for installations to provide to utility companies reluctant to collaborate.

Allow a longer payback for UESCs. To address barriers related to the short UESC contract and thereby payback limit, the limit should be increased to 30 or even 40 years. This payback extension would allow greater flexibility, such as incorporation of renewable energy projects.⁶

Speed up the federal process. In general, the federal process for approving a UESC should be streamlined to speed up UESC implementation. For instance, addressing key roadblocks, such as the often slow path to contracts approval, will help signifi-

⁶ It is important to note that installations could and should still do UESC contracts with shorter lengths, such as a 10- or 15-year contract, as appropriate. For example, in cases where the longevity of a structure is in question, a long-term contract would not be advisable, and a shorter contract term, such as 10 years, would be more appropriate.

cantly in speeding this process. This step helps address utility companies' concerns that the military takes too long to develop and implement UESCs.

Alleviate Energy Staff Issues

Installations have several options to overcome the barriers presented by energy staff issues. These options fall into four main categories: (1) ensure sufficient energy staff and raise the level of the energy manager, (2) provide a UESC policy and a handbook on how to do UESCs, (3) provide more training on UESCs and other utility collaboration opportunities, and (4) provide more technical assistance to installations.

Ensure sufficient energy staff and raise the level of the energy manager.

Having a full-time energy manager with energy management training and experience on staff at the installation would help solve many issues with lack of staff time and expertise. This position should ideally be offered at least at the GS-13 level for larger installations to lessen the frequency of staff turnover and ensure that qualified people stay in the position. To help address the shortage of energy staffing, installations could also employ one or more Resource Efficiency Managers (REMs) to supplement energy management staff as much as possible. REMs often have good experience, training, and technical expertise that they can bring to energy efficiency projects.

Provide policy and a handbook on how to do UESCs. ACSIM should provide installations with a policy and handbook detailing how UESCs are implemented. These aids would facilitate the education of installation energy staff and better prepare them to utilize UESCs. The draft UESC policy that ACSIM developed in 2009 is a good first step.⁷ ACSIM and IMCOM in collaboration with other commands should also develop a more detailed UESC handbook that provides detailed installation case study examples of how to successfully implement UESCs, including addressing lessons learned from previous experiences. Detailed case studies are needed to show how utility collaboration helps the installation save money, reduce energy consumption, improve installation operations, and improve energy reliability and security.

Provide more training on UESCs and other utility collaboration opportunities.

In general, installation energy staff need to receive more training and education on UESCs and how to collaborate with utilities. ACSIM, IMCOM, and other commands should help fund travel so energy staff can attend UESC workshops often hosted by FEMP and the Federal Utility Partnership Working Group (FUPWG) conferences to receive such education; provide relevant GovEnergy conference sessions; and facilitate mechanisms for cross installation information sharing, such as hosting monthly conference calls.

⁷ For presentations by ACSIM on this policy, see Randy Smidt, "Army Policy Guidance for Utility Energy Services Contracts," presented at the Federal Utility Partnership Working Group, May 5, 2009, and Randy Smidt and Amy Solana, "Army Policy Guidance for Utility Energy Services Contracts," presented at the Federal Environmental Symposium, Bellevue, Washington, June 2–4, 2009.

Provide more technical assistance to installations. To increase staff knowledge or technical expertise, more technical assistance should be provided to installations through organizations such as PNNL, which currently assists in installation and utility collaboration. IMCOM should continue to sponsor PNNL's assistance to installations in starting, developing, and implementing UESCs.

Improve Legal and Contracting Staff Expertise

Education is needed to overcome the legal and contracting staff issues, and we provide three main recommendations for how to do this.

Increase time devoted to UESCs in standard Army legal educational curriculums. UESC training should be included in the Judge Advocate General (JAG) school classes. While the basic JAG school course has a quick overview of ESPC, UESC, and PPA contracting mechanisms, the UESC and other utility collaboration material should be reviewed and perhaps expanded. Other legal training to assist installation contracting staff in UESC implementation could include having UESC training in the annual environmental course, including UESC issues as part of contracting legal courses, or including it at the Government Contract Law Symposium.

Provide UESC training to installation staff. ACSIM, IMCOM, Mission and Installation Contracting Command (MICC), and other relevant commands should help installation legal and contracting staff receive more information and training about UESCs. Four activities could help. First, legal contracting staff could attend UESC workshops to learn more about utility collaboration. Second, the new UESC policy should include a section that explains the role of installation contracting officers and mention the specific legal language and documents that authorize UESCs. Third, a more detailed UESC handbook should also be developed and provided to legal and contracting staff. Fourth, FEMP has developed contractor training regarding UESCs, and installation contracting staff should attend this training.

Assist reluctant and overworked contracting staff. A Center of Expertise on UESCs should be established within the Army Headquarters contracting office, i.e., at MICC headquarters. This center would serve as a resource to installation staff and could refer inexperienced installation contracting staff to other installation contracting staff with UESC experience. Another suggestion is to have UESC-trained contracting staff available at Defense Logistics Agency–Energy (DLA–Energy)⁸ and USACE Huntsville, the organization that administers ESPC contracts. A third option to help address this issue is to refer installation contracting staff to contracting staff members from another installation who have UESC experience. A fourth option is to refer contracting staff to ACSIM/IMCOM energy offices or PNNL to get technical assistance. ACSIM/IMCOM energy offices might also be able to refer contracting staff to appropriate MICC staff to help out as well.

⁸ Formerly the Defense Energy Support Center (DESC).

Other Installation Support Issues

To overcome the other installation staff support issues, we have grouped these options into four main categories: (1) increase education on and visibility about UESCs, (2) have UESC/utility collaboration/energy training in commander's courses, (3) provide DPW staff with more resources and knowledge, and (4) educate financial and business staff about UESCs. Since this first category focuses on the need for a UESC policy and handbook and since these recommendations were already discussed, we only discuss the other three categories here.

Have UESC/utility collaboration/energy training in commander's courses. Interviewees also stated the importance of getting basic energy, UESC, and utility collaboration information into garrison commander and installation and other senior commander classes. Such education would not have to be extensive, but should help expose such senior leaders to the basic concepts and why they are important. For example, such commanders should be taught about the importance of installation energy goals, and how UESC and other utility collaboration can help meet such goals, can save money, and can be important to the continued operation and sustainability of the installation mission by ensuring long-term reliable power.

Provide DPW staff with more resources and knowledge. Key DPW staff, such as the DPW director, should be encouraged by ACSIM and IMCOM to attend UESC workshops, FUPWG conferences, and relevant GovEnergy sessions to gain UESC and utility collaboration knowledge. ACSIM and IMCOM can also help provide collaboration technical assistance, such as leveraging PNNL's UESC assistance activities. PNNL should also provide relevant DPW staff with technical assistance, as they do with the energy manager and other installation staff. DPW staff shortages in areas with energy responsibilities should be addressed to allow ample staff time for UESC implementation and other utility collaboration activities.

Educate financial/business staff about utility collaboration. Financial and business staff need to know more about UESCs and other utility collaboration opportunities. ACSIM, IMCOM, and other relevant commands should encourage and help provide travel funds so such staff can attend UESC workshops, FUPWG conferences, and GovEnergy sessions. Working with FEMP to locate UESC training near large installations would help in this process. ACSIM, IMCOM, and the other Army commands should also provide training about energy financing mechanisms and provide staff with business case studies regarding utility collaboration. In addition, financial and business staff should be involved earlier in the UESC and other utility collaboration processes so that they more fully understand and become a part of the processes.

Renewable Energy Investments

The Army needs to deal with the barriers to expanding the use of renewable energy and take better advantage of these opportunities. Recommendations to do that fall into the following categories: (1) encourage, support, and document more renewable energy

experiments at installations, (2) expand installation staff education and training, (3) allow a longer payback period for UESCs, as long as 30 years or more, for greater flexibility, and (4) improve collaboration with utilities in renewable energy through Army policies and guidance. Since we already discussed the advantages of the 30-year payback for UESCs, we only discuss the other three categories.

Encourage, support, and document more renewable energy experiments at installations. ACSIM, IMCOM, and the other Army commands should encourage and support efforts for renewable energy experiments at installations. Such support needs to include research and financial and technical assessments regarding what are the most feasible, productive, and cost-effective renewable energy resources for an installation given its location and available renewable resources. All successes at actually implementing renewable energy projects—both small- and large-scale examples—should be documented so that the installation can try renewable energy projects on a larger scale or so that other installations can try similar projects. Such documentation, especially for the larger and more complex projects, should include in-depth case studies. These case studies should discuss the process of assessing and implementing the renewable energy project and lessons learned, including barriers encountered and how they were overcome. ACSIM/IMCOM should help installations document these successes.

Expand installation staff education and training. ACSIM, IMCOM, and other Army commands should increase staff education and training with regard to renewable energy and how to implement projects. More conferences and workshops should be planned, funded, and attended by installation energy staff. For instance, the Army funded PNNL, which hosted an Energy Summit in Richland, Washington in July 2008 with the theme “Moving Forward with Renewable Energy.” Installation energy managers and other staff attended the summit and increased their awareness of renewable energy options. Helping fund installation energy staff’s travel to such workshops and other relevant Department of Energy, regional, and national conferences, such as GovEnergy, is another important role for ACSIM and IMCOM given installation funding limitations.

ACSIM/IMCOM should also facilitate more networking across installations so that energy managers can exchange information on renewable energy technologies. In addition to conferences, they could have conference calls, SharePoint sites, or other Internet-based collaboration forums to help installation staff network regarding renewable energy. Additionally, ACSIM or IMCOM should provide in-depth “how-to” case studies for renewable energy projects. Installation energy managers have expressed a need for real implementation help on a step-by-step basis.

Improve collaboration with utilities in renewable energy through Army policies and guidance. Army policy and guidance should encourage more on-site power generation, power purchase agreements (PPAs), and enhanced use leasing (EUL) deals regarding renewable energy technologies. ACSIM should be developing installation

renewable energy policy guidance, like the draft UESC policy, that includes a discussion of the importance of such tools for collaborating with utilities in renewable energy projects. Besides helping improve utility collaboration with installations in renewable energy, such policy guidance is needed to help installations reach the Army's renewable energy goals. Additionally, through policy and guidance, ACSIM, IMCOM, and other relevant commands should encourage more energy security collaboration that takes advantage of renewable energy technologies where they can. Army policy should also state that installations should take advantage of federal, state, and local renewable energy incentive programs where they can, even if only for initial pilot experiments.

Dealing with Other Issues That Limit UESC Implementation

We have identified two main options to address problems where the lack of sufficient M&V, O&M, and building commissioning limit successful UESC implementation: (1) the new UESC policy should ensure appropriate M&V, O&M, and building commissioning; and (2) the UESC handbook should provide examples of successful M&V, O&M, and building commissioning.

UESC policy should ensure appropriate M&V, O&M, and building commissioning. In terms of M&V, ACSIM should ensure that the new UESC policy requires M&V planning that goes beyond the first year to ensure UESC project success over time. Installation staff or the utility should do periodic M&V assessments. Appropriate M&V can be built into the UESC contract or conducted by the installation.

Additionally, ACSIM needs to ensure that the new UESC policy will include appropriate planning that ensures effective O&M. An installation can provide some independent external O&M oversight that helps improve O&M; it can involve installation O&M staff in the UESC project technology selection and implementation process and ensure that they have proper training; or it can outsource O&M to a qualified contractor as part of the UESC contract. Regardless of which approach is used to ensure effective O&M, the new UESC policy should require that installations develop a maintenance plan.

The new UESC policy should also recommend that installations include building commissioning as part of their UESC. Where possible, a third-party independent commissioning agent should be employed for the building commissioning.

Since this study was done, in October 2010 the Army issued an updated Sustainable Design and Development Policy stating that "facility construction projects will use total building commissioning practices."⁹ However, it is still unclear if such building commissioning is happening in the field given the extra costs and tight construction budgets.

⁹ Department of the Army, OASA (Installations, Energy and Environment), "Sustainable Design and Development Policy Update (Environmental and Energy Performance)," Washington, D.C., October 27, 2010.

UESC handbook should provide examples of successful practices. As an additional resource, ACSIM should develop a UESC guidance handbook that provides detailed examples of successful M&V, O&M, and building commissioning practices so that these can be implemented at other installations. Again, these should include a detailed “how-to” for the practices so that they are more easily implemented. IMCOM should develop detailed case studies for this handbook.

Addressing Other Impediments to Installation and Utility Collaboration

We recommend five key activities to address these broader collaboration issues in the following categories: (1) provide information and training on non-UESC collaboration mechanisms to installation staff, (2) increase information exchange and collaboration with utilities and utility associations, (3) take more advantage of utility interest in key areas, (4) provide more information and training on such opportunities in these key areas, and (5) ensure that installations can use incentives for energy program investments.

Provide information and training on non-UESC collaboration mechanisms to installation staff. ASCIM, IMCOM, and other commands should provide information and training to installation staff on non-UESC collaboration mechanisms such as EULs, PPAs, and USCs, through conferences, classes, and documented case studies. For example, presentations at the GovEnergy conference are an effective method to get some of this information across to installation staff. Detailed installation case studies could provide a step-by-step “how-to” for installation staff to implement these non-UESC collaboration mechanisms. Such case studies should include lessons learned, barriers that were encountered and how to overcome them, and sample contracts and contracting language. In general, information and training that is provided to installation staff by ACSIM and IMCOM needs to have more emphasis on these non-UESC collaboration mechanisms. They should also encourage installations that have successfully used such mechanisms to network with energy managers at other installations.

Increase information exchange and collaboration with utilities and utility associations. Additionally, ACSIM, IMCOM, and other commands should increase the information exchange and collaboration with utilities and utility associations. ACSIM should schedule regular meetings with utility associations and major utilities to discuss key areas of interest including on-site collaboration, financial mechanisms, energy security, metering, smart grid, and demand response. ACSIM already started such a process when it had a meeting with Edison Electric Institute (EEI) representatives in June 2008 to discuss areas of mutual interest. ACSIM and IMCOM also need to ensure that they participate in relevant meetings and working groups that utilities are taking a leading role in.

Take more advantage of utility interest in key areas. Utilities already have interests in certain key areas that installations should be taking more advantage of, including on-site power generation, energy security, metering and smart grid deployment,

and demand response and other incentive programs. ACSIM, IMCOM, other commands, and installations should be pursuing more collaboration in such areas. ACSIM and IMCOM should help encourage and fund installation pilots in such areas. They have already done some of this in supporting the Forts Carson and Irwin on-site solar power generation projects and pursuing net zero energy use buildings on installations. More of these activities need to be pursued. For example, more installations should try to participate in demand response programs.

Provide more information and training on such opportunities in key areas. Another recommendation is for ACSIM, IMCOM, and other commands to provide more information and training on such opportunities regarding on-site collaboration, energy security, metering, smart grid, demand response, and other incentive programs to installation staff. The Army should help encourage and provide special sessions on these topics at key conferences, such as GovEnergy and FUPWG. ACSIM and IMCOM should also consider providing special workshops and conferences on these topics. The Department of Defense, other Services, and the Department of Energy also could be potential partners in helping with such workshops. For example, FEMP could help provide training to installations about participating in demand response programs. Once installation staff are more informed about and equipped to address these areas, they should be able to more easily pursue collaboration opportunities with utilities.

Ensure that installations can use incentives for energy program investments. Lastly, ACSIM should try to ensure that installations can use incentives for energy program investments. A main reason installations do not participate in demand response and other utility incentive programs is because the installation energy program has difficulties in accepting or getting the rebate checks. Often, the money goes back to the federal government general fund rather than to the installation energy program. Some installations have found ways to address this issue, such as taking discounts on utility bills, but the Army needs to streamline some of the red tape required to make this happen so that installations can more easily take advantage of incentives.

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¹⁰ Fort Lewis and McChord AFB have now merged to form Joint Base Lewis-McChord (JBLM) but were still separate at the time of this study.

List of Acronyms

ACSIM	Assistant Chief of Staff for Installation Management
AWC	Areawide Contract
BOA	Basic Ordering Agreement
BPA	Bonneville Power Administration
BRAC	Base Realignment and Closure
COP	Coefficient of Performance
DA	Department of the Army
DECAM	Directorate of Environmental Compliance and Management
DLA-Energy	Defense Logistics Agency–Energy
DOC	Directorate of Contracting
DoD	Department of Defense
DOE	Department of Energy
DOL	Directorate of Logistics
DPTM	Directorate of Planning, Training, and Management
DPW	Department of Public Works
ECIP	Energy Conservation Investment Program
ECM	Energy Conservation Measure
ECP	Energy Conservation Project
EEI	Edison Electric Institute
EISA	Energy Independence and Security Act
EMCS	Energy Management Control System

EPAcT	Energy Policy Act of 2005
ESCO	Energy Service Company
ESPC	Energy Savings Performance Contract
EUL	Enhanced Use Leasing
FEMP	Federal Energy Management Program
FUPWG	Federal Utility Partnership Working Group
GSHP	Ground Source Heat Pump
HQDA	Headquarters, Department of the Army
HVAC	Heating, Ventilation, and Air Conditioning
IMCOM	Installation Management Command
IOU	Investor-Owned Utility
IR	Infrared
JAG	Judge Advocate General
LED	Light-emitting diode (light or light bulb)
LEED	Leadership in Energy and Environmental Design
M&V	Measurement and Verification
MCA	Military Construction Army
MILCON	Military Construction
O&M	Operations and Maintenance
PAO	Public Affairs Office
PNNL	Pacific Northwest National Laboratory
PPA	Power Purchase Agreement
PSE	Puget Sound Energy
PUC	Public Utility Commission
REC	Renewable Energy Credit
RECC	Rural Electric Cooperative Corporation
REM	Resource Efficiency Manager
RFP	Request for Proposals
SCE	Southern California Edison

SPPO	Strategic Plans and Program Office
TPU	Tacoma Public Utilities
TVA	Tennessee Valley Authority
UESC	Utility Energy Service Contract
USACE	U.S. Army Corps of Engineers
USC	Utility Service Contract
USGBC	United States Green Building Council
WAPA	Western Area Power Administration
WBR	Whole Barracks Renewal

Introduction

Background

Energy awareness is increasing in the United States and with it the demand for ways to reduce energy consumption and get more energy from renewable sources. Congress and the administration are seeking ways to accomplish both goals and have passed significant legislation and regulations in recent years that have established benchmarks and guidelines for energy efficiency and renewable energy implementation. The Energy Independence and Security Act (EISA) of 2007 directed military installations to reduce their building energy consumption 30 percent by 2015, and the Energy Policy Act of 2005 (EPAct) directed them to obtain 7.5 percent of their electricity from renewable sources by 2013.¹ Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” issued in October 2009, directs federal agencies, including the Army, to increase energy efficiency and to measure, report, and reduce their greenhouse gas emissions.

The U.S. Army is a large energy consumer, spending significant funds to light and heat the buildings on its many installations. In 2010, the cost of Army installation energy utilities was over \$1.2 billion.² Furthermore, the Army’s energy bill is likely to go up because energy prices are likely to do so, especially with ongoing concerns and policies to address climate change. If a carbon tax is implemented on a larger scale, it will add another cost to Army installations with high energy use. Thus, in addition to being mandated to comply with energy laws and regulations, the Army is motivated to reduce energy usage to save money. Energy security concerns, such as the desire to run partially or fully independent of the grid in an emergency situation, also motivate Army reductions in electricity use. To help meet such goals, Army installations are striving to become Net Zero Energy Installations (NZEIs), and in April 2011 the Army announced six pilot installations that are trying to become NZEIs by 2020 and two that are trying to achieve net zero for energy, water, and waste by 2020.

¹ U.S. Library of Congress (U.S. LOC), “H.R.6 Energy Independence and Security Act of 2007,” 2007.

² Personal communication with ACSIM staff, August 4, 2011. Note that this statistic does not include any transportation energy, just the installation energy utilities.

The Army has an active energy program to meet these federal energy requirements, conserve resources, and reduce costs. However, installations have limited options for funding programs and making long-term investments to help achieve energy goals. Furthermore, installations do not have any dedicated funding for energy efficiency or renewable energy projects. One way to reduce energy consumption, lower costs, help meet energy security goals, and fund projects is for Army installations to work closely with utility companies. Installations can collaborate with utilities for mutual benefits in a number of different ways. To help with funding issues, an installation can partner with a utility in a Utility Energy Service Contract (UESC). A UESC is a partnership between the installation and a utility in which the utility pays for upfront costs of energy efficiency projects and the installation pays this money back from its energy savings over time.

Purpose

The Assistant Chief of Staff for Installation Management, Headquarters, U.S. Army, asked RAND Arroyo Center to develop recommendations on how the Army's installations could improve collaboration with utility companies to reduce energy consumption and help meet other Army energy goals. The project had four tasks:

- Examine how Army installations currently collaborate with utility companies.
- Identify problems with, or barriers to, such collaboration.
- Identify and assess options for improving collaboration.
- Recommend ways the installations and utilities could improve collaboration.

Methodology

This research study was conducted primarily from early 2008 through early 2010. Our assessment was conducted using four integrated methods: a review of relevant literature, attending relevant conferences and workshops, installation and utility company visits and phone interviews, and interviewing other relevant experts.

Our literature review covered relevant national, Defense Department, Army, other Service, and Department of Energy (DOE) policies and technical documents. Installation documents, such as energy management plans, UESC documents, renewable energy assessments, and DOE's Federal Energy Management Program (FEMP) documents and websites were important resources. We also reviewed relevant utility trade press and federal, state, and local government energy and utility policies.

RAND researchers attended relevant conferences and workshops including the 2008 GovEnergy conference,³ two different UESC workshops, and the Fall 2008 Federal Utility Partnership Working Group (FUPWG) conference. At these forums, we gathered relevant information and literature, established contacts for later interviews, and conducted informal interviews.

We visited or conducted phone interviews with diverse installation staff from about twenty military installations, with about fifteen of them being Army installations. At Fort Knox, Fort Irwin, Fort Lewis, Edwards Air Force Base (AFB), and McChord AFB, RAND researchers spent one to two days interviewing energy program, legal and contracting, master planning, Department of Public Works (DPW), garrison commander's office, and financial staff, as well as utility partners. At other installations, we interviewed energy staff, utility representatives, and others for twenty minutes to two hours in person or over the phone. These installations included Forts Campbell, Carson, Belvoir, Bragg, Bliss, Huachuca, Leonard Wood, Rucker, and Stewart; U.S. Army Garrison Hawaii; and Camp Pendleton. We also interviewed a diverse range of utility company representatives and utility associated staff, such as Edison Electric Institute (EEL) staff, and visited a Southern California Edison (SCE) educational resource center.

RAND researchers also interviewed other relevant energy experts at ACSIM, IMCOM, FEMP, DOE's Pacific Northwest National Laboratory (PNNL), the Office of the Secretary of Defense (OSD), energy service companies (ESCOs), and the U.S. Army Corps of Engineers (USACE). All told, between the installation visits and the other interviews, we interviewed about 50 people. The interviews focused on identifying ways that installations and utilities do and could collaborate, barriers to collaboration, and ways to overcome the barriers and improve collaboration for mutual benefit.

How the Report Is Organized

The next chapter provides background about Army energy goals, its overall energy program, and installation energy investment options. It also provides some information on the types of utility companies that provide power to installations. Chapter Three describes the various ways that installations can collaborate with utility companies, and summarizes the range of benefits to installations and utilities from this collaboration. Chapter Four discusses the barriers to collaboration, and Chapter Five makes recommendations for ways to overcome the barriers to installation-utility company collaboration.

³ GovEnergy is an energy training workshop and trade show held once a year for federal agencies and other relevant organizations. For more information, see <http://www.govenergy.com/Index.aspx>.

This report has four appendixes: (A) Fort Campbell, (B) Fort Carson, (C), Fort Knox, and (D) Fort Lewis (which also includes a small section on McChord AFB). Each is a case study of an Army installation's collaboration with its utilities. These installations were chosen to illustrate different collaboration approaches and activities as well as the diversity of energy programs and circumstances of Army installations, such as different types of utility providers, state incentive programs, and renewable energy resources. Forts Campbell and Knox both have long histories implementing UESCs, but implementation details are different in many ways. Fort Knox also does multiple UESC task orders each year. Fort Lewis was the first federal entity to ever do a UESC in 1992, so it also has a long history of UESC use. However, it has not been quite as active a user over time. More recently, Fort Lewis implemented a large UESC, so this appendix describes its UESC development process, and Fort Carson has collaborated with utilities in renewable energy activities without using any UESCs. Forts Carson and Lewis both have energy programs that leverage their strong installation sustainability programs, and Fort Lewis became a joint base with McChord AFB in October 2010, now called Joint Base Lewis-McChord (JBLM). However, since in this report we are discussing these installations' activities prior to that date, we refer to them as Fort Lewis and McChord AFB throughout this document.

Background About the Army Energy Program and Installation Energy Investment Mechanisms

This chapter provides background information about the Army Energy Program. It begins by describing the main policy and regulatory drivers that specify Army Energy Program requirements, and then it briefly overviews program goals and activities. Since Army installations have limited funding for energy projects, it is important to understand what the funding mechanisms are. The chapter then describes various sources of funds that installations can use for energy projects, such as UESCs and Energy Savings Performance Contracts (ESPCs). The chapter concludes with a discussion of the different types of utilities. Not all utility companies are organized or operate the same way, so it is also important to understand the types of utility companies that installations use to get their power.

The Army Energy Program

The Army has had an aggressive program to try to reduce energy consumption since the 1980s. Much of what has driven this program has been federal policies and requirements to conserve energy. In this same period, most installations have seen rises in the demand for electricity and other energy types because of increasing use of computers and other electronic devices in facilities, vehicles, and equipment. In addition, some installations have increased their use of air conditioning, which also has increased demands for power. Such changing demands make it even more difficult for installations to achieve energy consumption reduction goals. For examples, see the appendix case studies.

This section provides background information about the more recent policies and regulations; it then provides a brief overview of some of the Army's energy goals and objectives.¹

¹ Since this research was completed in early 2010, the Army has had some changes in its energy policies and program. We briefly discuss some of these in this section. However, for more details on the current Army energy program, see <http://army-energy.hqda.pentagon.mil/>.

Policy and Regulatory Drivers

There have been several legislative acts, executive orders, and regulations in recent years that have put forth benchmarks and guidelines for energy efficiency and renewable energy implementation to which Army installations are subject. Federal-level regulations are largely grounded in the Energy Policy Act of 2005; Executive Order 13423, “Strengthening Federal Environmental, Energy, and Transportation Management”; the Energy Independence and Security Act of 2007; and Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance.”

The Energy Policy Act of 2005 (EPAc 2005) provided new statutory standards and financial incentives for voluntary actions for both public and private entities across a broad range of energy generation and energy saving technologies. Energy use by federal agencies was especially stressed, including renewable energy production incentives, renewable energy purchase requirements, and energy efficiency standards such as requirements to purchase Energy Star or FEMP-designated products.² A highlight of EPAc 2005 was the mandate to increase renewable energy use by 7.5 percent or more by 2013.

Released in January 2007, Executive Order 13423 built on EPAc 2005 and gave more explicit details to federal agencies, establishing the following general goals for the heads of all federal agencies:

- (a) improve energy efficiency and reduce greenhouse gas emissions of the agency, through reduction of energy intensity by (i) 3 percent annually through the end of fiscal year 2015, or (ii) 30 percent by the end of fiscal year 2015, relative to the baseline of the agency’s energy use in fiscal year 2003;
- (b) ensure that (i) at least half of the statutorily required renewable energy consumed by the agency in a fiscal year comes from new renewable sources, and (ii) to the extent feasible, the agency implements renewable energy generation projects on agency property for agency use.³

The Energy Independence and Security Act (EISA) of 2007 made the energy intensity reduction goals of Executive Order 13423 statutory requirements and added requirements for measurement and verification (M&V). Specifically, energy intensity requirement for buildings codified Executive Order 13423’s energy intensity goals of a 3 percent per year reduction in Btu per gross square feet, with a 30 percent reduction by 2015 from an energy intensity baseline of 2003. EISA set the start date for reduc-

² Congressional Research Service, “Energy Policy Act of 2005: Summary and Analysis of Enacted Provisions,” CRS Report for Congress, The Library of Congress, March 8, 2006, and U.S. LOC, “H.R.6, Energy Policy Act of 2005,” 2005.

³ Executive Office of the President of the United States, “Executive Order 13423: Strengthening Federal Environmental, Energy, and Transportation Management,” January 26, 2007.

tions as 2005, with statutory goals starting in October 2008. Other renewable energy requirements of the EISA include: requiring new buildings or major building renovations to be net zero “fossil fuel-generated energy” by 2030 and a requirement for 30 percent of hot water demand to be met with solar hot water equipment, provided it is life-cycle cost-effective.⁴

Released in October 2009, Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” directed the Army and all other federal agencies to increase energy efficiency and to measure, report, and reduce their greenhouse gas emissions. Each agency has to develop percentage reduction targets for agencywide reductions of greenhouse gas emissions by the year 2020 based on a FY08 baseline, develop and implement plans to achieve these goals, and provide metrics and reports on their progress. Each agency is also directed to develop, implement, and annually update an integrated Strategic Sustainability Performance Plan. Agencies are also suppose to implement high-performance sustainable building design, construction, operation and management, and maintenance and deconstruction that includes zero-net energy by 2030. A “zero-net-energy building” means a building that is designed, constructed, and operated to require a greatly reduced quantity of energy to operate, meet the balance of energy needs from sources of energy that do not produce greenhouse gases, and therefore result in no net emissions of greenhouse gases and be economically viable.”⁵

In fall 2010, the Army announced a new Army energy vision for Net Zero Energy Installations (NZEIs). As defined by the Army:

A Net Zero Energy Installation (NZEI) is an installation that produces as much energy on site as it uses, over the course of a year. To achieve this goal installations must first implement aggressive conservation and efficiency efforts while benchmarking energy consumption to identify further opportunities. The next step is to utilize waste energy or to “re-purpose” energy. Boiler stack exhaust, building exhausts or other thermal energy streams can all be utilized for a secondary purpose. Co-generation recovers heat from the electricity generation process. The balance of energy needs then are reduced and can be met by renewable energy projects.⁶

The Army also has a broader goal, Net Zero Installations which means net zero energy, water, and waste objectives that are designed to conserve natural resources. By definition, “net zero installations will consume only as much energy or water as they

⁴ U.S. Library of Congress (U.S. LOC), “H.R.6 Energy Independence and Security Act of 2007,” 2007.

⁵ Executive Office of the President of the United States, “Federal Leadership in Environmental, Energy, and Economic Performance,” Executive Order 13514, October 2009, p. 14. See this Executive Order for more details about the energy-related requirements.

⁶ Army Energy Program, “Army Vision for Net Zero.”

produce and eliminate solid waste to landfills.”⁷ In April 2011, the Army announced six pilot net zero installations in each of the energy, water, and waste categories and two integrated installations striving toward net zero by 2020. The two integrated installations are Fort Bliss and Fort Carson. The six NZEI pilots are Fort Detrick, Maryland; Fort Hunter Liggett, California; Kwajalein Atoll, Republic of the Marshall Islands; Parks Reserve Forces Training Area, California; Sierra Army Depot, California; and West Point, New York. UESCs and other utility/installation collaborations are important to help these installations strive to reach their NZEI goals.

The Program Goals

The Army has an active energy program to meet these federal energy requirements, conserve resources, and reduce costs. The Army Energy Program strategy, signed by the Secretary of the Army and the Army Chief of Staff on July 8, 2005, details energy goals for the Army for the next 25 years.⁸ As a foundation for future energy management for the Army, “The U.S. Army Energy Strategy for Installations” sets forth five major initiatives.⁹ The wording of these initiatives was revised very slightly in 2007, and this updated version is presented in Table 2.1.¹⁰

Table 2.1
Initiatives of the U.S. Army Energy Strategy for Installations

Eliminate energy waste in existing facilities.	Reduce and eliminate energy inefficiencies that waste natural and financial resources, and do so in a manner that does not adversely impact mission or the comfort and quality of the facilities in which soldiers, families, civilians, and contractors work and live.
Increase energy efficiency in new construction and renovations.	Increase the use of energy technologies that provide the greatest cost-effectiveness, energy efficiency, and environmental sustainability.
Reduce dependence on fossil fuels.	Increase the use of clean, renewable energy and improve efficiency of existing energy systems to reduce dependency on fossil fuels and to optimize environmental sustainability.
Conserve water resources.	Reduce water use to conserve water resources for drinking and domestic purposes.
Improve energy security.	Provide for the security and reliability of energy and water systems in order to provide dependable utility services.

⁷ OASA (Installations, Energy and Environment), “Net Zero Installations Identified.”

⁸ Army Energy Program, “Army Energy and Water Management Program,” updated January 4, 2010, at <http://army-energy.hqda.pentagon.mil/>. This website is also a good reference for more information about the Army’s energy program and provides information on policies, regulations, financing, awards, etc.

⁹ For more information on this strategy document, see U.S. Army, “The US Army Energy Strategy for Installations,” July 8, 2005.

¹⁰ Department of the Army, “The U.S. Army Energy and Water Campaign Plan for Installations: The Army’s 25 Year Plan in Support of POM FY2010–2015,” December 1, 2007.

The “The U.S. Army Energy and Water Campaign Plan for Installations” was also issued in 2005 to help provide direction on implementation of the strategy. It provides direction for developing initiatives, approaches, and funding strategies to meet the Army energy and water goals; identifies tools, technologies, policies, management, and institutional requirements to achieve initiatives; describes the desired end state for the Army goals; identifies metrics and levels of performance considered a success; and provides a year-by-year resource requirement and investment plan. It was updated in December 2007.¹¹

The Army has established several programs to work toward these energy goals. These include the Army Metering Implementation Plan,¹² issued on September 6, 2006, which is intended to satisfy EAct requirements for all federal facilities to use advanced meters by 2012 where practicable. Other Army energy programs include distributed energy generation, including microturbines, fuel cells, combined heat and power, and renewable technologies; sustainable installation initiatives; and alternative fuel vehicle programs. ACSIM and IMCOM oversee installations in their efforts to meet these goals and the federal requirements. As one example of how they do this, they require that installations develop long-range energy management plans as road-maps for achieving energy management goals.¹³

The Army also has the Army Energy Security Task Force (AESTF), established by the Secretary of the Army in April 2008, to look specifically at energy security issues for the Army. The AESTF produced the Army Energy Security Implementation Strategy (AESIS) in January 2009, which sets forth the mission and goals of the Army’s energy security plan. The Army Energy Security Mission is:

Make energy a consideration in all Army activities in an effort to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability, while sustaining or enhancing operational capabilities.¹⁴

Table 2.2 details the Army’s five strategic energy security goals¹⁵ as set forth in the report. Progress on these goals is monitored by the Army’s Senior Energy Security Council (SEC).

¹¹ Department of the Army, “The U.S. Army Energy and Water Campaign Plan for Installations: Fiscal Year 2008–Fiscal Year 2013,” August 1, 2006, and the updated version: Department of the Army, “The U.S. Army Energy and Water Campaign Plan for Installations: The Army’s 25 Year Plan in Support of POM FY2010–2015,” December 1, 2007.

¹² For a copy of the “Army Metering Implementation Plan” and other information on metering, see Army Energy Program, “Army Metering Implementation Plan,” updated January 4, 2010.

¹³ For more information, see Army Energy Program, “Long-Range Energy Management Plans,” updated January 4, 2010.

¹⁴ Department of the Army, “Army Energy Security Implementation Strategy,” January 13, 2009.

¹⁵ Department of the Army, “Army Energy Security Implementation Strategy,” January 13, 2009, p. 4.

Table 2.2
The Army's Strategic Energy Security Goals

Reduced Energy Consumption	Reduce the amounts of power and fuel consumed by the Army at home and in theatre. This goal will assist in minimizing the logistical fuel tail in tactical situations by improving fuel inventory management and focusing installation consumption on critical functions.
Increased Energy Efficiency Across Platforms and Facilities	Raise the energy efficiency for generation, distribution, storage and end-use of electricity and fuel for system platforms, facilities, units and individual Soldiers and Civilians. This goal also relates to the productivity of a system based on energy requirements and supports the ability to make informed trade-offs in development, engineering and deployment of weapon systems.
Increased Use of Renewable/Alternative Energy	Raise the share of renewable/alternative resources for power and fuel use, which can provide a decreased dependence upon conventional fuel sources. This goal also supports national goals related to renewable/alternative energy.
Assured Access to Sufficient Energy Supply	Improve and maintain the Army's access to sufficient power and fuel supplies when and where needed. Energy is a critical resource in conducting Army missions. Vulnerabilities to external disruption of power and fuel sources should be minimized and the potential for industry partnerships to enhance energy security and generate net revenues for the Army should be considered.
Reduced Adverse Impacts on the Environment	Reduce harmful emissions and discharges from energy and fuel use. Conduct energy security activities in a manner consistent with Army environmental and sustainability policies.

Since our research was done, IMCOM has also made “Energy and Water Efficiency and Security” a Line of Effort in “The Installation Management Campaign Plan 2010–2017” which was released in April 2011, and set the following objective:

Create energy and water efficient installations by holding users accountable, modernizing facilities, installing new technologies, and leveraging partnerships that will provide Senior Commanders an increased level of energy and water security leading to sustainable and resilient infrastructure and mission assurance.¹⁶

This Installation Management Campaign Plan has implementation key-to-success objectives similar to the Army's strategic energy security goals.¹⁷ A key subtask of this plan involves the use of UESCs:

Develop alternative sources of energy to reduce dependence on fossil fuel sources through appropriate investments, public/private partnership or contracts such as Power Purchase Agreements (PPA), Energy Saving Performance Contracts (ESPC)

¹⁶ IMCOM, “The Installation Management Campaign Plan 2010–2017,” Version 3.0, April 2011, p. 39.

¹⁷ See IMCOM, “The Installation Management Campaign Plan 2010–2017,” Version 3.0, April 2011, for more information about the implementation details.

or Utility Energy Service Contracts (UESC) for resources installed on Army property.¹⁸

Funding Sources for Installation Energy Investments

Funds supporting installation activities are tight and have been getting tighter. Three primary options for funding that are outlined in the EISA are: (1) appropriations, (2) UESC, and/or (3) ESPC. Appropriated funds are funds authorized and appropriated by Congress for specified purposes. The main ones related to energy are: the Energy Conservation Investment Program (ECIP), Military Construction Army (MCA), and Operations and Maintenance Army. In limited cases, installations can acquire other appropriated funds, such as DOE technical assistance grants. Installations have no dedicated funding for energy efficiency projects, and often energy investments must compete for scarce funds. In addition, some energy efficiency projects require large initial investments, which makes it difficult to acquire sufficient funding. The following section details the list of mechanisms that installations can employ to fund energy investments.

Military Construction Army (MCA) Funds

Limited Military Construction Army (MCA) funds are available for energy efficiency projects including planning, programming, designing, budgeting, and executing new construction. These funds are regulated by AR 420-1, which outlines policies, procedures, and responsibilities for the Department of the Army (DA) military construction (MILCON) budget,¹⁹ and can be used because of the Army's Leadership in Energy and Environmental Design (LEED) 2.2 Silver requirement.

LEED is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings and was developed by the U.S. Green Building Council (USGBC). In 2008, ACSIM required Army new construction (NC) to be capable of achieving USGBC certification at the LEED-NC Silver rating. The LEED rating is based on a point system in which more points indicate a higher level of sustainability achievements. There are six LEED credit categories in which building projects must satisfy particular prerequisites and earn points. The six categories for LEED 2.2 are sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation in design. Energy projects that add points include more energy efficient equipment (which helps to achieve

¹⁸ IMCOM, "The Installation Management Campaign Plan 2010–2017," Version 3.0, April 2011, p. 42.

¹⁹ For more information see Army Energy Program, "Appropriated Funds–MCA," updated January 4, 2010.

energy performance credit), on-site renewable energy projects, and commissioning of the building's energy systems.²⁰

Because of the additional cost of certification, as of January 2010, the Army did not require any of its projects to be officially certified by the USGBC, only that they be built to "certifiable" standards. LEED construction and certification usually adds less than 3 percent to the overall building construction costs.^{21,22} When a building is certified by the USGBC, it reviews extensive documentation to verify that the building meets the LEED requirements. Most of the certification costs come from preparing the certification documentation that must go to the USGBC, which includes extensive receipts to verify that green building features—such as energy efficient light bulbs—were purchased and installed. For example, in 2004, for a Silver-certified 49,500-square-foot, \$11.5 million Consolidated Support Facility (CSF) at Edwards Air Force Base, it cost around 1 percent of the building's construction cost, about \$115,000.²³ Figure 2.1 shows the USGBC certification plaque for the CSF at Edwards AFB.

Since the buildings are not officially certified, even though this is an Army standard, energy efficient projects and other parts of the LEED standards are not always achieved. For example, it usually requires higher military construction costs to meet LEED standards, but since savings tend to occur in other military accounts, such as reduced operations and maintenance costs for energy, water, or wastewater disposal, LEED features, such as capital-intensive energy efficient equipment, are sometimes cut to save money as construction starts, particularly if costs are rising, so as not to overrun the MILCON budget.²⁴

Energy Conservation Investment Program (ECIP)

The Energy Conservation Investment Program (ECIP) is a Department of Defense (DoD) MILCON-funded program. This program is used to execute energy efficiency projects on DoD facilities that reduce associated utility energy and other related costs. The ECIP program focuses on energy and water savings, implementation of renewable energy, and converting systems to cleaner energy sources. The Army competes with the other Services to obtain these funds. In FY08, the Army was awarded 18 ECIP proj-

²⁰ A new LEED standard, LEED 3.0, was introduced in spring 2009 but had not yet become the Army standard by January 2010. For more details on LEED-NC standard (both LEED 2.2 and 3.0), see U.S. Green Building Council, "LEED for New Construction," 2010.

²¹ Greg Kats, "The Costs and Financial Benefits of Green Buildings," October 2003.

²² Steven Winter Associates, "GSA LEED Cost Study," October 2004.

²³ For more details about the cost of LEED certification, see Beth E. Lachman et al., *Developing Headquarters Guidance for Army Installations Sustainability Plans in 2007*, Santa Monica, Calif.: RAND Corporation, MG-837-A, 2009, p. 91.

²⁴ For more details about problems with buildings not achieving the LEED standard, see Lachman et al., *Developing Headquarters Guidance for Army Installations Sustainability Plans in 2007*, p. 69.

Figure 2.1
USGBC LEED Silver Certification Plaque for Edwards AFB CSF



SOURCE: Photo by Beth Lachman.

RAND MG1126-2.1

ects, which totaled approximately \$24 million, and in FY09, it was awarded 15 projects, which totaled about \$27 million.²⁵ Note that in FY09, the American Recovery and Reinvestment Act (ARRA) provided an additional 17 ECIP projects to the Army totaling more than \$32 million.²⁶ Army ECIP projects have included a range of energy efficiency and renewable energy projects. For example, Fort Bragg has used ECIP funds to install utility monitoring and control systems—i.e., an Energy Management Control System (EMCS)²⁷—in several buildings on the installation; Fort Knox, McAlester Army Ammunition Plant (AAP), and Fort Sill used ECIP funds for ground source heat pump (GSHP) projects; and Fort Drum, Aberdeen Proving Ground, Schofield Barracks, and Fort Bliss have used ECIP funds for solar projects.

²⁵ Army Energy Program, “Appropriated Funds—ECIP,” updated January 4, 2010. See this website (URL is in the bibliography) for more information about ECIP, including an ECIP guidance document for installations.

²⁶ This number can be compared with ECIP projects awarded to other services in ARRA: the Navy received 13 ECIP projects, the Marine Corps received 10 ECIP projects, the Air Force got 4 ECIPs, and 4 ECIPs were awarded to defense-wide projects; see http://www.defense.gov/recovery/plans_reports/2010/pdfs/DoD%20ECIP%20Program%20Plan%20Update_FINAL_062110.pdf.

²⁷ An EMCS is a computerized energy management system that uses control equipment, sensors, and software to monitor and manage buildings’ use of energy for heating, ventilation, air conditioning, lighting, and/or other processes. An EMCS can also be used to help with fire control, safety, and security management.

Installation Operations and Maintenance (O&M) Funds

According to DOE's Federal Energy Management Program, effective operations and maintenance promote "energy efficiency and lifecycle performance, which can save Federal agencies 5% to 20% on annual energy bills without significant capital investments. In addition, successful O&M programs can increase safety while improving comfort and health."²⁸ Insufficient energy systems maintenance often causes significant energy waste on installations. Installation O&M funds can be used to pay energy bills, fund repairs, and replace equipment. Some installations use these funds to invest in energy efficiency for cost savings.

However, installations often find it difficult to use O&M funds for energy projects. This is largely due to time constraints and the competition for scarce resources. O&M funds are intended to fund building or equipment maintenance and day-to-day operations rather than large-scale capital investments. O&M funds must be spent in one fiscal year, unlike MILCON funds, which can be used for up to seven years. By law, all construction must be funded 100 percent, so using O&M funds for energy efficiency projects can limit the size of a project, since the entire project has to be funded in one year. By contrast, MILCON dollars can be spent for larger energy efficiency projects. In addition, there are limited O&M funds, and energy projects must compete with other installation projects such as fixing leaking roofs and other maintenance issues. Often, "band-aid" types of fixes get necessary priority over energy efficiency projects.

Enhanced Use Leasing (EUL)

Another way to fund energy projects such as renewable power generation projects is to take advantage of the military Enhanced Use Leasing (EUL) program. Under the Army EUL program, which was started in 2001 and is managed by the U.S. Army Corps of Engineers, installations can fund construction or renovations by leasing underutilized land to a private developer through a competitive process based on the cost and speed of execution of a construction project. The lessee pays the installation in cash or provides in-kind services worth not less than the fair market value of the lease interest. In-kind services can include "construction of new facilities, restoration (including environmental), acquisition, alteration, and other services."²⁹ The EUL program has been used to build projects such as a hot weather military vehicle test track at Yuma Proving Ground, Arizona, and a central utility plant at Fort Detrick, Maryland.³⁰ An example of a project that involves using an EUL for solar power is at Fort Irwin. In July 2009, Fort Irwin was awarded an EUL to implement the largest DoD solar energy project

²⁸ FEMP, "Program Areas: Operations and Maintenance," U.S. DOE, updated February 16, 2010.

²⁹ Army Energy Program, "Other Funding Sources," updated January 4, 2010.

³⁰ For more information, see U.S. Army Corps of Engineers, "Enhanced Use Leasing: Official Web Site for the Army EUL Program," updated March 9, 2010.

proposed to date, which will also be the largest solar installation in the world and will include both photovoltaic (PV) and concentrating solar power (CSP) technologies. The first phase of the project will deploy more than 500 megawatts (MW) of capacity and generate an expected 1,250 gigawatt-hours (GWh) of solar electricity annually at the Fort Irwin facilities.”³¹

DOE Financial and Technical Assistance

DOE has some programs that can help Army installations invest in and implement more energy efficiency projects. The Federal Energy Management Program, the most relevant of DOE’s programs for direct assistance to installations, can provide limited funding for technical assistance at installations, such as performing feasibility studies, reviewing procurement specifications, and evaluating completed projects.³² FEMP can also provide utility collaboration assistance, including training and project facilitation. For example, FEMP helps organize and sponsor UESC training workshops and works with utilities to encourage them to do UESCs. DOE grants can also be used to invest in new energy technologies such as experimental renewable energies.

State and Utility Public Benefits and Incentive Programs

States and utilities also offer public benefits and incentive programs that can assist installation energy initiatives. For instance, they can provide information on efficiency and renewable strategies and technologies. Additionally, energy efficiency and renewable incentives and rebates may be available.³³ About 35 states have programs that provide \$3 billion annually in rebates and incentives for renewable energy and energy efficiency projects.³⁴ California provides renewable energy rebates and incentives for solar (including PV) systems and for wind and fuel cells. For example, any home builder is eligible for the Expected Performance-Based Incentive (EPBI) when installing qualifying solar electric systems on new, highly energy efficient residential buildings that meet the program’s requirements. In addition, the California Solar Initiative provides rebates for solar electricity systems on existing nonresidential buildings.³⁵ California also offers cash rebates on eligible grid-connected small wind and fuel cell renewable energy electric-

³¹ The National Training Center and Fort Irwin, “Welcome to the Fort Irwin, California Enhanced Use Leasing (EUL) Web Site,” updated July 30, 2009.

³² For more information about the different types of assistance that FEMP provides to military installations and other federal facilities, see FEMP, “About the Program: Energy Management at Federal Facilities,” updated October 8, 2009.

³³ For the most up-to-date information on state incentives, see North Carolina State University, North Carolina Solar Center, “DSIRE: Database of State Incentives for Renewables and Efficiency,” 2009.

³⁴ Richard Kidd, FEMP, Department of Energy, “Comments,” *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008, p. 3.

³⁵ For more details about the California solar rebates and incentives, see State of California, California Energy Commission, “Go Solar California,” undated.

generating systems.³⁶ Fort Irwin has had opportunities to receive rebates from its utility, SCE, through this California program.

Fort Lewis has been able to take advantage of Washington's Utilities Commission-sponsored energy efficiency rebates. See the Fort Lewis case study in Appendix D for more details.

Another example of state programs related to renewable energy is called the Renewable Portfolio Standard (RPS) or a Renewable Energy Standard (RES), which "is a state policy that requires electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date."³⁷ RPS defines specific characteristics of the providers to whom the policy applies and how the policy should be met.³⁸ State RPS policies do not apply specifically to military installations, but energy efficiency and renewable energy activities on installations can often count toward meeting benchmarks. For example, renewable energy produced on an installation can be sold as renewable energy credits (RECs)³⁹ that count toward compliance with a state's RPS. While not required to participate, many military installations have certain characteristics that may make them a relatively attractive location for meeting a state's RPS, such as remoteness, unobstructed open spaces, special financing options available to government entities, and the capability to make long-term investment decisions. Colorado's state RPS enabled Fort Carson to partner with utilities and a solar company to install a 12-acre, 2-MW solar array project.

Power Purchase Agreement

Another financial mechanism that installations can take advantage of in helping to collaborate with utilities to fund energy efficiency projects is the power purchase agree-

³⁶ For more details about California wind and fuel cell incentives, see California Energy Commission, "Consumer Energy Center," 2007.

³⁷ U.S. Department of Energy (DOE)/EERE, "States with Renewable Portfolio Standards," updated June 16, 2009. Some states use the term Renewable Energy Standard (RES) instead of RPS.

³⁸ For example, Colorado's RES makes distinctions based on (1) company type and size: 20 percent of retail electricity sales by 2020 for investor-owned utilities, but only 10 percent for electric cooperatives and municipal utilities serving more than 40,000 customers; (2) specific technology set-asides: 4 percent of RES for investor-owned utilities must come from solar technologies; and (3) geographic location: half of solar must be located on-site at customers' facilities. North Carolina State University, North Carolina Solar Center, "DSIRE: Database of State Incentives for Renewables and Efficiency," 2009.

³⁹ Renewable energy certificates are the intangible environmental benefits associated with generating one megawatt-hour of electric energy by a renewable resource. Renewable energy producers can sell the credits, as well as the power itself, to allow all renewable resources to compete on a level playing field with conventional resources by recognizing there are other external costs associated with fossil fuel sources. Organizations that are not located near the source of renewable generation can buy RECs and claim the benefits to meet their own or mandated renewable energy or environmental goals.

ment (PPA).⁴⁰ A PPA is a contract between a power generator and power purchaser for electricity or capacity (power or ancillary services). It can be used by the power generator to raise non-recourse financing. The lender is entitled to repayment from the profits. Installations can use a PPA to help fund large-scale renewable energy projects, as Fort Carson did. Fort Carson used a PPA through Western Area Power Administration (WAPA) as its contracting vehicle to fund its 12-acre, 2-MW solar array project (see Figure 2.2 for a photo of this solar array). This PPA used the energy support provision of Fort Carson's firm electric services (FES) contract with WAPA. Similarly, Nellis AFB also used a PPA to help fund and install the Nellis Solar Power Plant, a 14-MW solar photovoltaic system, which began operating in 2007.

Energy Savings Performance Contract (ESPC)

The Energy Savings Performance Contract (ESPC) is a partnership between the installation and a private sector company, known as an energy service company (ESCO). With this funding mechanism, installations can implement energy efficiency projects without upfront capital costs or special congressional appropriations. The private com-

Figure 2.2
Fort Carson Two-MW Solar Array



SOURCE: Photo courtesy of Fort Carson.

RAND MG1126-2.2

⁴⁰ For more information about PPAs, see FEMP, "Financing Mechanisms: Power Purchase Agreements," updated February 3, 2010.

pany pays for the energy efficiency investments, and the installation pays it back from its energy savings over time. The ESCO conducts a comprehensive energy audit to identify the potential project and guarantees that the anticipated savings from the project will cover its costs. After project costs are repaid over a 10- to 25-year time period, all additional savings accrue to the installation.⁴¹ Approximately \$2.3 billion has been invested in U.S. federal facilities through more than 460 ESPCs. The resulting savings is estimated to be over 18 trillion Btu annually.⁴²

Utility Energy Service Contract

The Utility Energy Service Contract (UESC) is a partnership between the installation (or other federal customer agency) and a utility company that enables the implementation of energy efficiency projects. It allows the utility company to provide the installation comprehensive energy and water efficiency improvements and demand reduction services. Like the ESPC, UESC projects are funded through their anticipated savings. The utility company arranges financing and covers the upfront capital costs of the project. The utility company assesses, designs, and implements energy efficiency projects with optional O&M and optional M&V. The improvement project is intended to reduce energy costs sufficiently to allow for repayment to the utility company over a period of ten years.⁴³ Figure 2.3 illustrates the intended savings plan.

According to FEMP, by 2008 more than 45 gas and electric utilities had completed about \$2 billion in energy projects at federal facilities through UESCs, with approximately \$135 million reported in FY07.⁴⁴ To implement a UESC, first the installation or other federal facility must have a contracting vehicle.

Four main types of contracts are used for a UESC: (1) areawide contracts (AWCs), (2) basic ordering agreements (BOAs), (3) agency master agreements, and (4) site-specific contracts. The AWC is a blanket contract that serves as a basic shell for the agreement. It is an agreement between the General Services Administration (GSA) and a utility to provide for utility service needs for federal facilities, including military installations. The AWC “spells out general terms and conditions and authorizes any agency in the utility’s service territory to place delivery orders for services offered

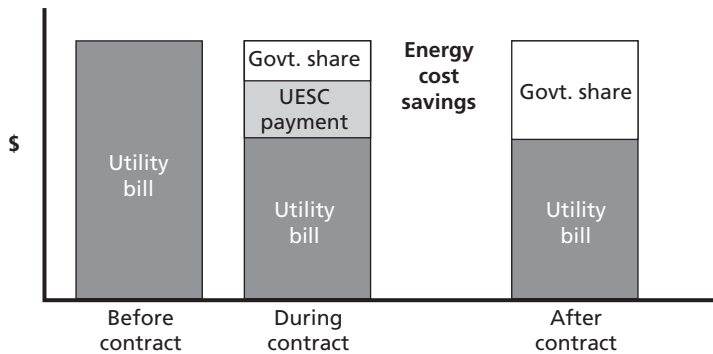
⁴¹ For more information on ESPCs, see Army Energy Program, “Alternative Financing—ESPC,” updated January 4, 2010.

⁴² FEMP, “Financing Mechanisms: Energy Savings Performance Contracts,” updated September 3, 2009. Also see this website for more information on ESPCs.

⁴³ For more information on UESCs, see Army Energy Program, “Alternative Financing—UESC,” updated January 4, 2010, and FEMP, “Financing Mechanisms: Utility Energy Services Contracts,” updated October 28, 2009.

⁴⁴ Richard Kidd, FEMP, Department of Energy, “Comments,” *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

Figure 2.3
Anticipated Energy Savings Generated by UESCs



SOURCE: Federal Energy Management Program, "Utility Energy Services Contracts: Enabling Documents," U.S. DOE, DOE/GO-102000-1111, Revised October 2001, p. 2.

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under the contract"⁴⁵ but does not contain specific terms of the agreement. More than 150 AWCs have been established by GSA.

Basic ordering agreements are umbrella agreements that allow multiple task orders to be placed and significantly reduce the time it takes to implement a project once in place.⁴⁶ A task order is an action entered into for any activity related to an Energy Conservation Measure (ECM). A task order established by an installation under a BOA becomes a specific contract and describes the services to be delivered. BOAs are not contracts but establish general terms and conditions including those for delivery and conditions. BOAs can then be used to issue task orders that become a binding contract with payment procedures. The BOA is an agreement between the federal agency and the utility that supplies it services.

An area master agreement is similar to a BOA because it is an agreement between DoD and a utility that individual installations use by developing task orders. It is different in that it does not specify what must be included in the contract or when it must be reviewed and updated. A model utility service agreement for DoD agencies was developed by a team of DoD, FEMP, and EEI representatives. This agreement serves as a template for military installations to use in establishing UESCs.⁴⁷

⁴⁵ FEMP, "Financing Mechanisms: Types of Utility Energy Service Contracts," updated October 28, 2009. For more information on AWCs, see David McAndrew, "Utility Energy Services Contracting Overview," briefing, FEMP, 2006.

⁴⁶ David McAndrew, "Utility Energy Services Contracting Overview," briefing, FEMP, 2006.

⁴⁷ This model agreement can be found at <http://www1.eere.energy.gov/femp/pdfs/modelagreement.pdf>.

Site-specific contracts are also between a federal agency and a utility, but they are written for a single installation instead of all that agency's installations. Putting together a site-specific contract can take more time, but can include special provisions for installation-unique circumstances. Site-specific contracts can use the language from the model agreement or other contract samples to help speed the process. These agreements contain all essential language and are the most comprehensive of the UESC agreements.

A UESC has several phases once a basic contract is in place. First, once an ECM proposal is evaluated, the government issues a task order with the utility company for the project. Specifically, a task order is a "binding contractual action entered into under this Agreement for the feasibility study, engineering and design, implementation, and/or operation and maintenance of, or any activity related to an ECM."⁴⁸ A task order may also be identified as a delivery order. This task order may have five phases: audit (when applicable), feasibility study phase, engineering and design phase, implementation phase, and operation and maintenance phase.⁴⁹

Comparison of UESCs and ESPCs. UESCs and ESPCs are both useful tools for funding energy investments. In fact, an OSD 2008 memorandum states that "components shall endeavor to annually" invest a minimum 10 percent of the component's energy costs in ESPCs and UESCs.⁵⁰ Some installations choose to implement both funding mechanisms, while others choose to employ only one or the other. Much of the basic framework of the two is the same (e.g., upfront capital costs are covered for the installation, payback occurs over a period of years and is financed by the project's savings, etc.).

However, UESCs and ESPCs differ in important ways. First, with a UESC, the installation partners with a utility company, while with an ESPC, it partners with a private company or ESCO and the contract must be competed. A benefit of UESCs is that energy staff at some installations have found that it can be easier to work with a utility rather than an ESCO. The installation typically has had a long relationship with the utility company, and this relationship often becomes more of a partnership rather than just contracting out a project. Having the utility company serve as the single point of contact for the UESC makes implementation easier. Also, public utility commissions (PUCs) often provide strong motivation for utility companies to help installations save energy. Still, one limitation of UESCs is that some utility companies do not choose to participate in them, whereas an ESCO can carry out an ESPC any-

⁴⁸ FEMP, "Utility Energy Services Contracts: Enabling Documents," U.S. DOE, DOE/GO-102000-1111, Revised October 2001, p. 111.

⁴⁹ FEMP, "Utility Energy Services Contracts: Enabling Documents," Federal Energy Management Program, U.S. DOE, DOE/GO-102000-1111, Revised October 2001, p. 115.

⁵⁰ OSD, "Energy Savings Performance Contracts and Utility Energy Savings Contracts," OSD Memorandum, January 24, 2008.

where in the country. Another major difference between the UESC and ESPC relates to savings. The ESPCs often guarantee a specific level of savings, theoretically reducing financial risk; assuming the guaranteed savings is part of the contract, M&V stipulations are usually made to verify these savings. O&M requirements are also made part of an ESPC to try to ensure that all equipment and systems involved in the project will continue to function properly and accrue savings. UESCs, on the other hand, do not guarantee savings and, as such, generally have an optional M&V and O&M component. Including guaranteed savings and O&M increases the upfront cost of a project, so ESPCs are generally considered more expensive than UESCs. Conversely, there is some risk associated with a nonguaranteed UESC contract, which varies with the types of technologies deployed and the technical sophistication and resources of the staff at a given installation. Utilities also can often get better loan interest rates and tend to have lower overhead rates than private companies, which also tends to lower the cost of a UESC compared to an ESPC. Additionally, utilities are generally more willing to take on smaller, phased, higher-risk, or bundled projects than ESPCs, which allows for greater flexibility in project scope in UESCs. UESCs also offer flexibility by enabling the ability to quickly use year-end money and by also enabling bridge loans for capital equipment where long lead time is required for acquisition. Another major difference between these two funding mechanisms for the military is the payback term. According to OSD and Army legal interpretation, a UESC must have a simple payback period of 10 years, while an ESPC allows for up to 25 years for payback. The longer payback period makes projects with slower returns, such as renewable energy projects, more feasible to implement. However, this is a military policy. Other federal agencies have no such restrictions and UESCs can last for 25 years.

It should be noted that how an ESPC or UESC is implemented, especially how the contract services are provided over time, can greatly affect its success. We heard of examples of successes and problems with both ESPC and UESC implementation. One of the main concerns for both was that energy savings were not being achieved as expected, which could hurt energy achievements and affect how cost-effective the projects were over the long term. Later in this report, when we discuss some of the barriers and how to address them, we discuss such issues with UESCs. Here, we provide examples of problems related to ESPC implementation.

From the different Army and U.S. Air Force (USAF) installation staff, we heard of problems with the performance of the ESCO with the EPSC contract, including those with performing appropriate O&M and M&V and achieving the expected energy savings. For example, at one installation there were ongoing problems with the particular ESCO contractor, which was “nonresponsive”: Every year when it came time to turn the heat on, post staff would have to repeatedly call the contractor, often having to go up the chain of command to get results and ultimately threatening nonpayment. Then the contractor would become responsive, but concern and attention would again drop off during the maintenance season (i.e., the nonheating season); no preventive

maintenance would be performed; and the cycle would repeat the following fall when temperatures began to get cool. At another installation, the M&V reports provided by the ESCO were not accurate, claiming higher energy savings than what the actual performance was. So even when M&V and O&M are part of an ESPC contract, they still are not always implemented properly.

Types of Utilities

Electric power in the United States is generated by either traditional electric utilities or nonutility power producers. There are more than 3,273 traditional electric utilities and approximately 1,738 nonutility power producers in the United States. Traditional electric utilities include investor-owned, publicly owned, cooperatives, and federal utilities, as shown in Figure 2.4. For traditional electric utilities, “power marketers buy and sell electricity, but usually do not own or operate generation, transmission, or distribution facilities.”⁵¹ Traditional electric utilities are regulated by local, state, and federal authorities, and for cooperatives by their boards of directors. It is important to note that regulations can vary significantly by state and local area. Nonutility power producers include Qualifying Facilities (QF) established under the Public Utility Regulatory Policies Act of 1978 (PURPA), independent power producers that produce and sell electricity on the wholesale market, and other combined heat and power plants.⁵²

It is important to note that the potential for profit from a UESC can be a motivator for many utilities to implement a UESC. However, many participating utilities, particularly public utilities, may be precluded by law or utility commissions from profiting from these contracts. These utilities are motivated to participate by other factors. Another key motivator for many utilities to collaborate with installations in UESCs and other energy efficiency projects are concerns about meeting growing energy capacity demands. Namely, many utilities do not want to invest in new power generation, so energy efficiency is important to them. Federal and state renewable energy requirements also motivate some utilities to collaborate with installations in renewable energy projects. The next chapter illuminates more of these motivators when discussing the benefits to utilities from installation collaboration.

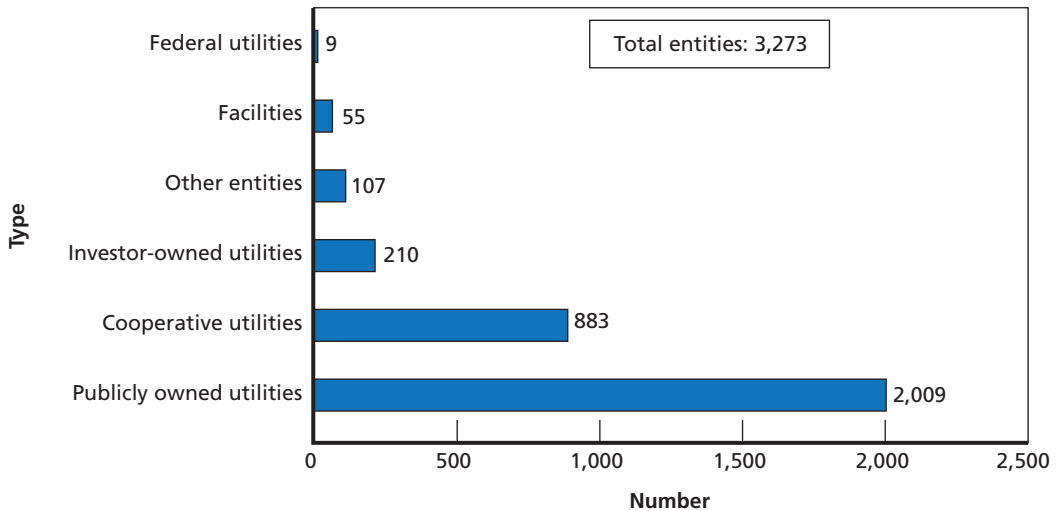
Investor-Owned Utilities

Investor-owned utilities (IOUs) are privately owned, for-profit entities and are also known as private utilities, private power companies, or shareholder-owned utilities. In

⁵¹ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007,” undated.

⁵² U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007.”

Figure 2.4
Traditional Electric Utilities in the United States in 2007



SOURCE: Energy Information Administration, State Electricity Profiles 2007, Table 9, p. 416.

NOTE: “Facilities” consist of cogenerators, other industrial generators, and qualifying facilities that are selling energy to industrial or residential customers under a regulated rate schedule. “Other entities” consist of retail power marketers or energy service providers that sell either the energy or the delivery services, but not both, to end use consumers.

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terms of electricity, “state public service commissions have jurisdiction primarily over these large, vertically integrated, investor-owned electric utilities that own more than 38 percent of the Nation’s generating capacity and serve about 71 percent of ultimate consumers.”⁵³ There are 210 investor-owned electric utilities in the United States. Companies in this category include Dominion Virginia Power, Pepco, Southern Company,⁵⁴ and Southern California Edison. Another example of this type of utility is Tucson Electric Power, which has collaborated with Fort Huachuca in exploring the viability of wind power on post. Progress Energy is an investor-owned utility that has collaborated with Fort Bragg in the past.⁵⁵ Because they are regulated by PUCs, private utilities are increasingly being statutorily required to increase efficiency and reduce demand, which helps motivate more interest in UESCs and other collaborative projects.

⁵³ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007,” undated.

⁵⁴ Southern Company is a large UESC player whose territory includes many Army installations.

⁵⁵ Due to recent change in state law, Progress and Fort Bragg are no longer collaborating on UESCs; Bragg is now looking into working with other local utilities, such as the natural gas provider.

Publicly Owned Utilities

Publicly owned utilities are not-for-profit government entities and include municipals, public utility districts and public power districts, state authorities, irrigation districts, and joint municipal action agencies.⁵⁶ There are 2009 publicly owned utilities, comprising 61 percent of the electric utilities in the United States. Examples include:

- Tacoma Public Utilities, which is regulated by its Public Utility Board, whose members are appointed by the Tacoma City Council.
- San Diego Gas and Electric, which is regulated by the California Public Utilities Commission.
- Colorado Springs Utilities (CSU), which services Fort Carson and is governed by its Utilities Board, which is made up of members of the City Council.

Cooperative Utilities

Cooperative utilities are owned by their members, who are the customers they serve. There are 883 cooperatives operating in 47 states, and comprising about 27 percent of electric utilities in the United States, although only about 4 percent of generation and generation capacity. Examples include:

- Pennyrile Rural Electric Cooperative Corporation (RECC), serving nine counties in Kentucky.
- Nolin Rural Electric Cooperative Corporation (RECC), which has partnered with Fort Knox on UESCs.
- Southern Alabama Electric Cooperative, which has partnered with Fort Rucker on UESCs.

Cooperatives tend to operate in rural areas, which investor-owned utilities may view as unprofitable areas due to the low number of customers per line-mile.⁵⁷ Cooperatives are governed by their boards of directors, who are elected by the members.

Cooperatives often are focused less on profit and more on providing a service to their customers and saving energy. As the vice president of Nolin RECC pointed out about working with Fort Knox, Nolin RECC staff are “committed to helping our members in whatever way we can. As a member-owned cooperative, our primary focus is not increasing revenue, but helping our members conserve energy.”⁵⁸

⁵⁶ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007,” undated.

⁵⁷ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007.”

⁵⁸ Comment by Nolin RECC vice president Vince Heuser, from FEMP, “Financing Mechanisms: Case Study—Fort Knox Strikes Energy-Savings Gold in Partnership with Utility,” July 2002.

Federal Utilities

There are nine federal utilities in the United States. The Tennessee Valley Authority (TVA) is the largest federal energy producer. Power generation owned by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation is marketed by the federal power marketing administrations, such as Bonneville Power Administration (BPA) and the Western Area Power Administration (WAPA). Of the more than 3,200 traditional electric utilities in the United States in 2007, the nine federal utilities provided approximately 4 percent of generation and 7 percent of generation capacity. Federal utilities are not subject to rate regulation; however, they are required to submit their rates to the Federal Energy Regulatory Commission to show that they are sufficient to repay debt owed to the federal government.⁵⁹ Federal utilities are often motivated to participate in UESCs and other collaborative arrangements to improve energy efficiency because of their interests in national energy goals, policy, and regulations.

Historical Rate Regulation and Recent Restructuring

The electric power industry was traditionally monopolistic and vertically integrated everywhere in the United States (i.e., a single entity provided generation, transmission, and distribution in a given region, and rate payers had no option to select alternate power providers). In this setting, consumers paid cost-based rates, which were approved by state PUCs and could not be increased without PUC approval. Beginning in the late 1990s, some states opted to restructure to a more market-based approach. This transition has sometimes been referred to as “deregulation,” although this is something of a misnomer because many aspects of electricity, such as environmental compliance or voltage requirements, remain subject to regulation even if *rates* are now based on retail competition. The restructuring has led to the development of regional electricity market structures based on regional trading practices and stakeholder preferences. For example, the Northeast, Midwest, and California have wholesale markets operated by Regional Transmission Organizations (RTOs) or Independent System Operators (ISOs), and other states are not part of such a large wholesale regional market.⁶⁰ This distinction in rate structuring can influence the decisions that utilities make, for example, by making it more or less difficult for a utility to recover costs through rate increases.

⁵⁹ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007.”

⁶⁰ U.S. Department of Energy, Energy Information Administration (DOE/EIA), “Electric Power Industry Overview 2007.”

How Installations Collaborate with Utility Companies

As part of this research, it was important to examine and understand the different ways that installations and utilities work together. We found that installations and utilities have and can collaborate together in many different ways. In this chapter we discuss this range of activities. In addition, we found many benefits to both installations and utilities, and, as a result, we also found that both utility companies and installations would like to increase their collaboration activities for mutual benefit. However, many barriers limit the collaboration opportunities. In this chapter we discuss the benefits identified by this research, and in the next chapter we discuss the barriers limiting the collaboration opportunities.

Ways Installations Can Collaborate with Utility Companies

Installations can collaborate with utility companies in numerous ways to advance the Army's energy goals. The most visible collaboration between utilities and installations is the UESC. However, utility companies provide additional services to installations and often work closely in a number of areas, many of which can spin off from having a successful UESC collaboration.

It is important to note that not all utilities provide the types of collaborative services mentioned in this section. PUC requirements and federal, state, and local regulations, policies, and incentives often affect what utilities will and will not do. In general, in parts of the country where there are strong state and local energy regulations and requirements and/or PUCs, such as in California and Colorado, that require utilities to reduce energy demand and invest in renewable energies, utilities offer more of the collaborative opportunities discussed here.

UESC Collaboration

Many Army installations, like other U.S. military installations and other federal agencies, have entered into UESCs to implement energy improvements at their facilities. In fact, by fall 2008, utilities had completed about \$2 billion in energy projects through

UESCs with approximately \$135 million reported in FY07.¹ By December 2009, over 240 UESC task order/delivery orders had been done at over 30 Army installations with total investments of over \$316 million. Army installations that have implemented, or are in the process of implementing, UESCs include Fort Bragg, Fort Campbell, Fort Irwin, Fort Knox, Fort Lewis, and White Sands Missile Range. Some installations, like Fort Knox, began implementing UESCs in the mid-to-late 1990s and have over 10 years of collaboration experience. By the fall of 2008, Fort Knox had implemented 91 UESC projects in collaboration with Nolin RECC and had achieved significant energy savings because of these UESC projects. Fort Knox UESC projects have included GSHP installations, boiler upgrades and replacements, lighting retrofits, window/roof replacements, HVAC system replacements, occupancy sensor installations, high-efficiency motor retrofits, EMCS equipment, photovoltaics, and natural gas extraction test wells. UESC projects also pay for operations and maintenance staff for these projects, including staff to monitor Fort Knox's extensive Trane Tracer Summit EMCS, which is in over 250 buildings (see Figure 3.1 for a photo of one of the EMCS displays).²

Many different energy efficiency projects are possible using a UESC. Table 3.1 provides examples of possible Energy Conservation Projects (ECPs) that are possible within a UESC. Often a UESC task order will consist of multiple ECPs combined together as identified by an energy audit. We found that Army and other military installations often implement a combination of many of these ECPs based on an energy audit and to help make the project feasible within the 10-year payback requirement. For example, a common combination is to include lighting retrofit projects, with a short payback period, with HVAC or boiler upgrades, which have a longer payback. For detailed examples, see the installation case studies.

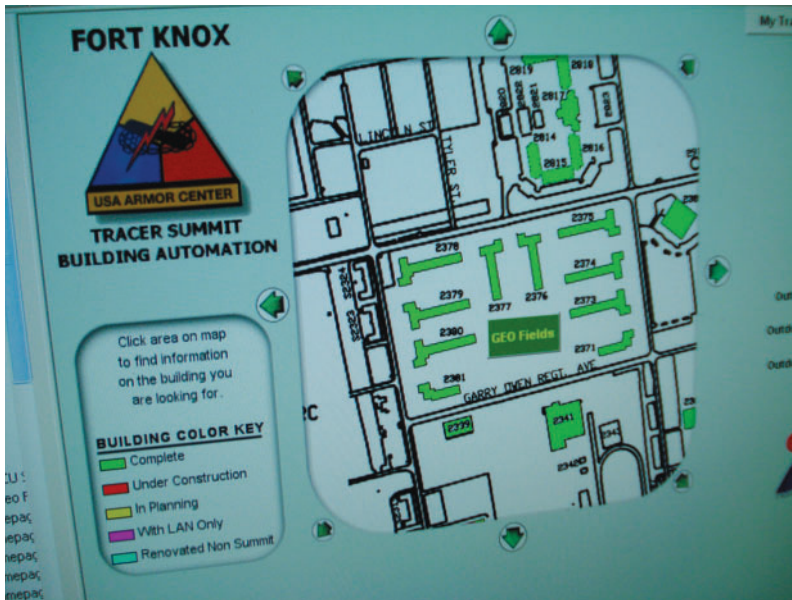
Utility Service Contracts (USCs)

Installations also use Utility Service Contracts (USCs), which provide energy utility distribution and transmission systems on the installation. Energy-related upgrades to such systems may or may not produce energy savings. However, USCs can also be used by installations to sole source some energy efficiency projects. An example of this is solar-powered and energy-saving street lighting at Fort Irwin. Southern California Edison has a 15-year service agreement with Fort Irwin for servicing solar street lighting across the post through the USC. SCE has also provided an experimental light-emitting diode (LED) street light at Fort Irwin through the USC (see Figure 3.2). A USC can be a useful tool in cases where appropriated funds need to be used expeditiously, e.g., at the end of a fiscal year.

¹ Richard Kidd, FEMP, Department of Energy, "Comments," *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

² For more details on its UESC program and savings explanations, see the Fort Knox case study in Appendix C. This appendix also includes some other EMCS photo samples: see Figures C.6 and C.8.

Figure 3.1
Fort Knox EMCS Display



SOURCE: Photo by Beth Lachman.

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Collaboration in Energy Security and Reliable Service

Most utilities work closely with their Army installation customers to ensure that they have ongoing power and reliable service. In the event of power outages, such as those caused by hurricane, tornado, brown-outs, accidental outages, or other manmade or natural disasters, utilities try to ensure that installation power is restored as soon as possible and keep the installation commander informed. Many utilities also work closely with installation staff when they need to temporarily shut off power because of routine maintenance work, in order to minimize disruptions to the installation's operations.

Utilities can also help installations ensure their energy security. They may work with an installation on backup power plans in the event of an emergency. They also may site a power generation plant on an installation in exchange for energy security benefits, as several Air Force bases have done, such as Robins AFB in collaboration with Georgia Power. Warner Robins Air Logistics Center (located at Robins AFB) sought on-site power generation at the same time that Georgia Power was looking into increasing peak capacity, so they collaborated. The result was Georgia Power building, owning, operating, and maintaining a power plant at Robins AFB. It consists of two nominal 80 MW, dual-fuel, combustion turbines. Georgia Power pays a lease to the U.S. Air Force for the use of the land. Robins AFB has the right to first production in the event of extended outage or power quality issues, ensuring energy security for the base.

Table 3.1
Examples of Energy Conservation Projects Possible with a UESC

Type of Energy Conservation Project
Interior and exterior lighting replacement
Transformer replacement
Lighting control improvements
Motor replacement with high efficiency motor
Construction of alternative generation or cogeneration facilities
Boiler control improvements
Packaged air conditioning unit replacement
Cooling tower retrofit
Economizer installation
Energy management control system (EMCS) replacement/alteration
Occupancy sensors
Light-emitting diode (LED) exit sign installation
Fans and pump replacement or impeller trimming
Chiller retrofit
Upgrade of natural gas-fired boilers with new controls (low NOX burners)
Solar domestic hot water system
Solar air preheating system
Steam trap maintenance and replacement
Insulation installation
Variable speed drive utilization
Weatherization
Window replacement
Window coverings and awnings
Reflective solar window tinting
Fuel cell installation
Photovoltaic system installation
Faucet replacement (infrared sensor)
Replacement of air conditioning and heating unit with a heat pump
Addition of liquid refrigerant pump to a reciprocating air conditioning unit
High efficiency refrigerator replacement
High efficiency window air conditioner replacement
Water conservation device installation (e.g., flow restrictors, low flow flush valves, waterless urinals, horizontal axis washing machines)
Installation, maintenance and operation of power quality and reliability measures including UPS systems, backup generators, emergency generators
Fuel switching technology
Infrared heating system
Heat pipe dehumidification
Flash bake commercial cooking
Thermal energy storage system
Operation distribution and collection system
Training that will result in reduced energy costs
Power factor correction measures and equipment
Installation, maintenance and operation of standby propane facility
Installation, maintenance and operation of gas distribution system and associated equipment
Water distribution system leak detection, and cost-effective repair

SOURCE: UESC Model Agreement in FEMP, "Utility Energy Services Contracts: Enabling Documents," U.S. DOE, DOE/GO-102000-1111, Revised October 2001, pp. 113–114.

Figure 3.2
Fort Irwin Experimental LED Street Light



SOURCE: Photo by Kimberly Colloton.

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Utilities Providing Energy Audits

Utilities often provide free or fee-based energy audits, where utility company representatives review individual buildings or groups of buildings and facilities at an installation to identify potential energy efficiency projects. Often, these audits examine a large number of buildings and facilities and identify a range of different energy efficiency projects and sometimes also include water conservation projects. For example, Public Service Company of New Mexico provided a free on-site energy audit at White Sands Missile Range that identified over 60 diverse energy and water efficiency project opportunities, including installing a central steam plant to replace broken equipment, repairing a photovoltaic system, replacing incandescent and low-efficiency fluorescent lights, installing EMCSs, installing a compressed natural gas vehicle-fueling station, improving the efficiency of boilers, installing a generating system to supplement the electricity purchased during peak hours, and installing a supervisory control and data acquisition (SCADA) system to monitor electricity consumption.³ Such audits can help identify O&M needs as well. Often such energy audits are conducted to help

³ For more information, see FEMP, “Total-Solutions Approach at White Sands Missile Range,” Utility Services Case Study fact sheet, July 2002.

identify UESC projects, but they are also used to identify other opportunities, such as renewable energy or USC project ideas.

Utilities Providing Technical and Other Assistance

Utilities can also provide a range of technical assistance for their installation customers, and some become trusted advisors and true partners in improving installation energy management and efficiency.

Utility companies sometimes provide free or fee-based assistance for reviewing, identifying, choosing, installing, or operating energy efficient and/or renewable energy technologies. For example, SCE provided free technical advice that helped the Chino Navy Exchange learn about and install High Velocity Low Speed (HVLS) fans. Sometimes such technical assistance includes studies and installation of the actual technology. For example, at Fort Lewis, Bonneville Power Administration (BPA) completed a project to provide voltage regulation of transformers in its substations to improve energy efficiency and a small study on customer assistance, both at BPA's own expense.

Such assistance can even include legal, regulatory, and financial advice on project implementation and even ESPC contracts. Some installations often develop a close working relationship with their utilities and see them as trusted advisors that they turn to for a range of advice related to energy issues. For example, at one U.S. AFB, the local utility provided free legal, regulatory and financial advice about a EPSC contract that the base staff was negotiating with an ESCO. Similarly, Fort Irwin's contracting and DPW staff meet regularly with SCE staff to discuss energy issues on post and SCE staff provide useful insights about increasing the post's energy efficiency activities.

Utilities Providing Training and Education

Some, but not all, utilities also offer free energy efficiency and technology training and education. Utilities that are more strongly motivated to save energy offer a range of classes and have a wide range of expertise to help their customers save energy. SCE, for example, even has two educational resource centers that provide demonstrations and training in energy management and energy efficiency solutions to help installations and other organizations save energy and money. (See Figure 3.3 for a photo of one of the demonstration areas at one of these educational resource centers.) SCE offers basic and advanced classes on lighting, heating, ventilation, and air conditioning (HVAC), motors, and refrigeration. They also offer classes focusing on power quality, demand response, electrical safety, and food service technologies.⁴ Fort Irwin staff have taken the free power quality and other training classes. Many other Army installation staff take advantage of such classes offered by their utilities. Fort Campbell energy staff has taken advantage of TVA's technical expertise and classes, including a course on

⁴ For more information on the types of classes that SCE offers to its customers, see Southern California Edison, "Energy Centers," 2010.

Figure 3.3
Southern California Edison Educational
Resource Center



SOURCE: Photo by Beth Lachman.

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mold and mildew problems in energy systems. Similarly, Fort Carson energy staff have attended Colorado Springs Utilities (CSU) classes about energy conservation, boilers, and xeriscaping (i.e., landscaping that reduces or eliminates the need for irrigation).

In some cases, utilities have even helped provide funding for installation staff to attend other training. One year, BPA provided funding for the registration fee so that McChord AFB energy staff could attend the Seattle Annual Energy Conference.

Collaboration in Renewable Energy

Installations also collaborate with utilities in exploring, investing in, and operating renewable energy projects and RECs.⁵ Since many renewable energy technologies are newer and less tested, they often require research, testing, and analysis before they can be installed, especially larger-scale projects. Some utilities can and have helped in this process. The U.S. Army Intelligence Center at Fort Huachuca, Arizona, partnered with Tucson Electric Power Company to install a 132-foot meteorological data tower and a

⁵ For more information about general opportunities for investing in renewable energy options, see U.S. EPA, "The Guide to Purchasing Green Power: Renewable Electricity, Renewable Energy Certificates and On-Site Renewable Generation," September 2004.

10-kW wind turbine to determine the viability of wind power as a source of electricity for Fort Huachuca.

Utilities also help installations purchase RECs because of the utilities' interests in meeting state and federal renewable energy goals. In 2005, Fort Carson partnered with eight other government agencies in an agreement with WAPA, which allowed a five-year REC purchase of 40,000 MWh/year, approximately 28 percent of Fort Carson's annual electrical consumption. Biomass from California sawmills provides 76 percent of the RECs, and the remaining 24 percent comes from wind farms located in California and Nebraska. Fort Carson made this purchase as a way to kick off its renewable energy program, but will not be buying more RECs. The RECs gave Fort Carson credit for supporting renewable energy production and are one way for Fort Carson to make immediate progress toward its renewable energy targets. Additionally, promoting renewable energy decreases the demand for finite and potentially less environmentally benign nonrenewable energy sources such as coal and natural gas.

Utilities also can play an important role in helping to finance, negotiate, and even build and operate on-site renewable energy generation projects. Installations have an interest in allowing on-site renewable energy generation to help meet their renewable energy and energy security goals. Utilities are motivated to participate in such projects to meet federal and state renewable energy requirements. Such projects are viable when the installation has a sufficient renewable resource (such as solar or wind), available land, acceptable mission and environmental impacts,⁶ favorable utility rates, and favorable renewable energy credits and incentives. Fort Carson partnered with Xcel Energy, a regulated utility operating in Colorado, to help develop and implement its 2-MW Ground Mounted Solar Array project on 12 acres at Fort Carson in 2007. As part of this deal, Xcel Energy buys Fort Carson's RECs from the project. The fact that Colorado has Renewable Portfolio Standards (RPSs) for 20 percent renewables by 2020 and publicly owned utilities in Colorado, like Xcel Energy, have to reach a 4 percent solar energy requirement by 2020, motivated Xcel Energy to participate in this deal. WAPA was also a key partner in this deal because of its PPA contracting vehicle, which was used. For more details on this solar array project, see the Fort Carson appendix.

Utility Helping to Provide Energy Staff

In a few cases, we also found that utilities even provide or help pay for experienced energy staff to work at an Army installation. A couple of years ago, SCE and the Army split the cost of Fort Irwin's resident Resource Efficiency Manager (REM).⁷ However,

⁶ In some cases renewable energy projects, most notably wind turbines both off and on post, have the potential to cause mission interferences because of low ground flight and radar interference. Such concerns need to be analyzed and addressed. Similarly, any environmental concerns, such as impact on threatened and endangered species, need to be considered.

⁷ REMs serve as contractors who work for the government and are effectively paid by the Army through a contracting mechanism, such as a UESC, generally with self-generated energy-related savings as stipulated in the contract.

he spent three days a week at Fort Irwin and only two days helping SCE, which was a good deal for the installation. Fort Irwin benefited by having a trained and experienced energy expert on staff who also brought important lessons and experience from the two days he spent working for SCE at other locations.

Utility Rebate and Incentive Programs

Some utilities have special rebate programs and incentives to motivate their customers to invest in energy efficient technologies. Utilities often are motivated to help their customers save energy so they do not have to build new power generation facilities. In addition, such programs are being implemented because of state regulations and PUC requirements to save energy and invest in renewable energies, such as in California. Within California there is the Savings by Design program, which helps facilitate high-performance nonresidential building design and construction. Sponsored by four of California's largest utilities under the auspices of the California PUC, "Savings by Design" offers assistance to customer building owners and their design teams to help them design the most efficient building possible, incentives to help offset the costs of energy efficient buildings, and additional incentives to reward designers who meet ambitious energy efficiency targets.⁸ Military installations have collaborated with utilities in this program. SCE is helping Fort Irwin put energy efficiency features in new buildings designed in their "Savings by Design" project for new privatized housing areas in Fort Irwin.

Demand Response

Utilities also like to work with installations in demand response. Demand response can be defined as "a short-term decrease in electrical consumption by end-use customers due to either: (a) increased electricity prices; or (b) incentive payments. Participation can be either through load curtailment (short-term conservation) or self-generation."⁹ There are two main program types: Reliability-based, which occurs in an emergency situation when the electricity demand is high and about to exceed existing capacity, thus creating risk of a brown-out; and price-based, i.e., economic, to reduce demand at high peak times when load is high. Basically, utilities provide price breaks to customers who are willing to have some power reduction during high-demand periods. Demand response programs benefit everyone: installations are paid for reducing demand, utilities avoid bringing on new generation and transmission, and resources are used more efficiently. As of the fall of 2008, 45 states had some form of demand response or load

⁸ For more details, see Southern California Edison, "Builder and Buyer: Savings by Design," <http://www.sce.com/b-rs/bb/savings-by-design.htm>

⁹ Phil Coleman, Lawrence Berkeley National Laboratory, "Demand Response in the U.S.—Key Trends and Federal Facility Participation," *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

management program. However, as will be discussed later, installations may have difficulty participating in demand response programs because sometimes they cannot directly receive the economic benefit since often the savings received must go back to the federal general fund instead of the installation.

We found a few installations participating in such programs. For example, Edwards AFB participates in an economic demand response program with SCE in which, during high demand periods, air conditioning is automatically shut off for 15 minutes in certain buildings every one to two hours to help reduce load and avoid potential brown-outs. The base receives significant cost reductions in its energy bills by participating in this demand response program.

Benefits of Installations Collaborating with Utility Companies

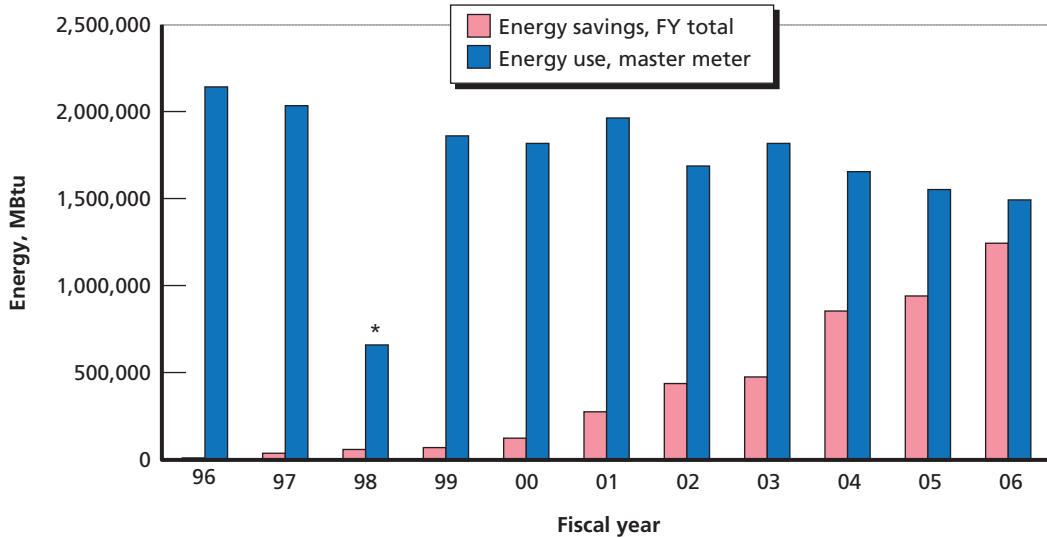
Our research revealed numerous benefits of installations collaborating with utility companies. There were benefits to both the installations and the utility companies. We briefly describe some of the main types of benefits for each group.

Collaboration Benefits for Installations

Based on our interviews with Army and other military installation staff and other relevant experts, we identified a range of benefits for Army as well as Air Force, Navy, and Marine Corps installations from collaborating with utilities. We have grouped these benefits into nine categories.

Saving Money and Decreased Energy Consumption. One of the main benefits to military installations from collaborating with utilities, especially with UESC projects, is saving money and decreased energy consumption. The money savings usually comes as future cost avoidance from saving energy. As was described earlier, with a UESC, the utility usually arranges financing to cover the capital costs of the project. Then the utility is repaid over the contract term from the cost savings generated by the energy efficiency measures. With this arrangement, installations benefit by implementing energy improvements with no initial capital investment, and the installation can also save time and resources by using the one-stop shopping provided by the utility. When a UESC is properly implemented, an installation can significantly reduce energy usage and thereby utility payments—thus, ultimately saving money. Between FY96 and FY06, Fort Knox had a 58 percent reduction in absolute energy consumption due mostly to its UESC projects. Figure 3.4 shows total energy savings relative to energy use for natural gas and electricity during this period of time. This chart shows how without the UESC collaboration and investments, Fort Knox would have used almost twice as much energy in 2006 compared to 1996, which would have cost this post almost double what it paid. Please see Appendix C for the Fort Knox case study and more details.

Figure 3.4
Fort Knox UESC Projects Total Energy Savings Compared to Total Energy Use
(Natural Gas Plus Electricity)



*Total energy use data not available for FY98. Value is for electricity only.

NOTE: This chart was calculated using the master meter data for the entire post for natural gas plus electricity. The year 1998 was missing natural gas data so this value is for electricity only, which is why the energy use bar is so much lower

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Increased Investments in Energy Efficiency Activities. Another main benefit to installations from collaborating with utilities is increasing investments in energy efficiency activities. As UESC examples from Fort Knox also illustrate, UESCs are one of the main ways that utilities help installations significantly invest in more energy efficient activities. These examples include ground source heat pump (GSHP)¹⁰ projects in over 250 buildings and a sophisticated wireless computerized building monitoring system—namely an EMCS—on over 8 million square feet of building space (for more details, see the Fort Knox case study in Appendix C). Similarly, Fort Campbell has installed more energy efficient boilers, HVAC systems, hot water heaters, lighting,

¹⁰ A ground source heat pump (GSHP), also sometimes called a ground coupled heat pump (GCHP) or geothermal heat pump, is a heating and/or cooling system that transfers heat to or from the ground to a building or water supply. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). This system takes advantage of the constant moderate temperatures underground to boost efficiency and reduce the operational costs of heating and cooling systems. Often the different names are used interchangeably. Fort Knox generally uses the term GCHP, and Fort Campbell uses the term GSHP; however, we have adopted the GSHP terminology in both cases as this appears to be the emerging convention in the Army and in the broader energy community. (Note that this technology is distinct from geothermal electricity generation, which makes use of very high temperature water or steam from greater below-surface depths.)

GSHP, and EMCS through UESC projects. Utility technical assistance can also help installations invest in their own energy efficiency projects. Installations use the free utility energy audits to help identify energy projects that they can fund through O&M funding and other ways.

Help Meet Renewable Energy Goals. Another benefit of utility collaboration is increasing installation investments in renewable energy technologies and helping installations meet their renewable energy requirements. Utilities can help with both large-scale and smaller-scale renewable energy investments. Projects can take advantage of UESC, PPA, and USC contracting arrangements to make these projects happen. The Fort Carson and Nellis AFB large-scale solar projects discussed earlier provide examples of helping with large-scale renewable energy technology investments with the help of PPAs. Installations have also been able to combine smaller-scale renewable energy projects in their UESC projects, with other shorter payback technologies (like lighting projects) which made them more economically feasible and helped get them implemented. Fort Knox was able to implement a small wind turbine pilot project as part of a UESC because of the UESC savings from the other technologies. Fort Detrick has considered solar hot water heaters and solar swimming pool heating as part of its UESC process. Camp Pendleton, a Marine Corps Base in Southern California, has used UESCs to help install solar street lights. Similarly, Fort Irwin used the USC mechanism to provide solar street lighting (see Figure 3.5). Utilities that have more experience with renewable energy technologies also can help provide some technical assistance. Installations have also been able to move closer to their renewable energy requirements by purchasing RECs from utilities, as Fort Carson did.

Improve Energy Security. Utility and installation collaborations on energy security issues also help installations meet key energy security goals, such as ensuring ongoing reliable power. For instance, deployment of on-site power generation capacity helps ensure that installations have power for mission critical functions during natural disasters, potential terrorist attacks, or other emergency power situations when the grid may go down.¹¹ Tinker Air Force Base and Oklahoma Gas and Electric (OG&E) partnered to install on-site power generation at the base that enables Tinker AFB to isolate itself from the power grid in the event of a natural disaster or other emergency situation. OG&E installed an 80-MW peaking generating station in 1988 and owns, operates, and maintains the plant. Tinker AFB provides the long-term ground lease at no cost to OG&E and has first right to the electrical power generated by the plant. OG&E is responsible for all electrical lines, connections, switches, metering, permits, pollution controls, and reporting. Tinker AFB benefits from the collaboration with OG&E because the plant provides energy security in the case of a disaster. Tinker AFB will be able to have power during a crisis or emergency, at no upfront cost to the base. The

¹¹ The energy security afforded by on-site generation requires an uninterrupted access to a fuel such as natural gas or diesel.

Figure 3.5
Fort Irwin Solar Street Light



SOURCE: Photo by Kimberly Colloton.

RAND MG1126-3.5

arrangement also confirms OG&E's commitment to providing reliable power to the base.¹²

Improve Installation Operations and Building Performance. We found that installations also improve their operations and building performance through these utility partnership activities. By having a close working relationship with utilities, it helps to ensure reliability of power and continuity of installation mission and functions. In 2008 when SCE had to impose a 12-hour power outage at Fort Irwin to repair a main utility line, it worked closely with the installation to schedule it at a time that would not disrupt installation operations. We also found that such successfully implemented collaborations can help improve building performance. From its UESC projects, Fort Knox increased comfort and reduced mold problems in its buildings, resulting in quality of life benefits. There were fewer complaints and problems regarding heating and cooling, and improved service, especially because of the significant investments in GSHPs, EMCS, and O&M. Having good service support from its utility and its contractors was key to this success. In some cases, installations also can save O&M costs. Both Fort Knox and Fort Campbell used their UESC processes to ensure

¹² *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia, FUPWG Fall 2008 Report, Fall 2008.*

reliable operations and maintenance of their HVAC and other equipment, helping to save O&M costs over the long term. Because of Fort Knox's UESC hospital boiler-chiller replacement project, the hospital went from needing five full-time maintenance staff for the old boiler system, to paying \$85,000 per year for maintenance service of the new system (see Figure 3.6 for a photo of this hospital's boilers).¹³

Receive Technical Assistance and Information from Utilities. Installations can also benefit by receiving technical assistance from utilities. Such assistance comes through the free energy audit and the technical classes that some utilities provide. Examples were mentioned earlier and are provided in the appendixes for how installations such as Forts Campbell, Irwin, Knox, and Lewis have taken advantage of such benefits. Such technical assistance also happens through the UESC development process and more informal processes. SCE staff meeting regularly with Fort Irwin DPW staff has provided informal technical assistance. Often, utility staff become trusted technical advisors. As mentioned earlier, at one Air Force base the utility was helping provide advice to the installation as it developed an ESPC.

Provide Benefits to Other Energy Efficiency Activities. We also found that a successful UESC program can provide spin-off benefits to other energy efficient projects

Figure 3.6
Fort Knox Hospital Boilers



SOURCE: Photo by Beth Lachman.

RAND MG1126-3.6

¹³ See Appendix C for more details on this Fort Knox UESC boiler-chiller replacement project.

at the installation, such as in ECIPs. Fort Knox's experience and success with installing and operating GSHPs through its UESCs helped the staff develop and implement six GSHP-related projects. Similarly, we found that successfully developing an effective EMCS through a UESC at an installation could lead to it being expanded through non-UESC efforts at the post. UESC success also can help motivate tenants to invest in energy efficient projects. Fort Knox UESC success convinced MEDCOM to participate in a UESC to put in a more efficient hospital boiler system and the USAF to invest in a GSHP system in one of its new buildings. Some installations also use the savings from UESC activities to invest in and improve their energy programs. Fort Campbell and Fort Knox both use their UESC savings to pay for a REM.

Do Things They Could Not Do on Their Own. Installations can also leverage utilities' staff expertise and service to be able to do things that would not be possible on their own, especially since many Army installations lack sufficiently experienced and trained energy staff (as will be discussed later in this report). Fort Lewis energy staff stated how critical BPA was in helping to develop their UESC, and they could not have done it without the help.

Develop Long-Term Collaborative Partnership for Mutual Benefits. We found that many installations have developed a long-term relationship with utility companies, which leads to more beneficial collaboration and synergistic benefits. Often, this relationship builds on a strong UESC partnership arrangement and history, like Fort Knox's with Nolin RECC. Such synergistic long-term relationships also build off of knowledgeable and dedicated utility staff that take the time to regularly meet and work with installations as SCE staff do with Fort Irwin and Edwards AFB personnel and as San Diego Gas and Electric staff do with Camp Pendleton and San Diego-area Navy installation personnel.

Benefits for Utility Companies

Based on our interviews with utility representatives, we also found a range of benefits that the utility companies receive from collaborating with military installations through UESCs and other activities. We have grouped them into eight categories.

Make a Profit and Help the Bottom Line. One of the main benefits to utility companies from collaborating with installations is increasing profit. Investor-owned utilities have to answer to their shareholders and show a profit. Similarly, the other utility types also want to show to their constituents that they are doing well. A utility also benefits by having a good working relationship with Army installations, since they are usually large customers and what they do can have a significant impact on a utility's business. In fact, in many rural areas, the Army post is the largest customer of the local utility company. Working together with installations on projects—such as UESC projects, demand response, or renewable energy projects—benefits utilities' bottom lines.

Help Meet Energy Consumption Reduction Goals. Another benefit to utilities from collaboration with installations is helping them to meet their energy consump-

tion reduction goals. Utilities are having to meet more and more federal and state energy requirements and goals, especially ones related to reducing overall energy consumption. A UESC is a good tool to help utilities get large federal energy consumers such as military installations to invest in energy conservation projects that reduce energy use. Installations participating in demand response programs and incentive programs also help reduce energy consumption. Because they are regulated by PUCs, private utilities are increasingly being statutorily required to increase efficiency and reduce energy demand. Similarly, since federal utilities are concerned about national energy goals, policy, and regulations, they find UESCs and other collaborations with installations to improve energy efficiency beneficial.

Help Avoid Having to Build New Power Plants. A closely related benefit for utilities is the ability to avoid having to build new power generation capacity. BPA is collaborating with Fort Lewis through a UESC and wants to achieve real energy efficiency savings in the face of population growth and the need to meet growing energy capacity demands. If a utility can avoid building a new power plant by helping a large Army installation reduce its energy consumption, it is a significant savings to the utility. Power plants are extremely expensive and capital intensive to build, not to mention the significant political and regulatory difficulties in doing so as well. Installations participating in demand response programs also help utility companies avoid the need for additional capacity and can help avoid brown-out problems. By having California military installations—like Fort Irwin and Edwards AFB—participate in demand response programs, SCE and other California utilities can avoid brown-out problems that have happened in the past in California during hot summer days when the energy grid is stressed to its limits.

More Easily Build a New Power Plant on an Army Installation. Utilities may also benefit from being able to site a new power source, whether traditional fossil fuel or renewable energy, on a military installation.¹⁴ Building new power plants is not easy for utilities. They face increasing environmental, regulatory, and community pressures. It often is somewhat easier for a utility to build and operate a power plant on a military installation, which saves the utility time and money. It can also be better for community and public relations because it benefits the military and the community appreciates the energy security benefits to the military from on-post power generation. Such a power plant may also be a peak generation station and provide enough additional capacity to help avoid peak load and brown-out problems, as with the 80-MW power station that OG&E built and operates on Tinker AFB. OG&E benefits from the collaboration on this project through a rate-based peaking unit, assured regular

¹⁴ Note, however, that depending on the fossil fuel source, local air emissions may be a concern. For example, the large-scale use of diesel-powered generation on an installation could increase local or regional air pollution, which could cause health concerns, especially if the installation is in a Clean Air Act nonattainment area for air quality.

operation during peak load periods, and additional consideration for base electrical privatization.¹⁵

Help Meet Renewable Energy Goals. Collaborations with installations help utilities meet their renewable energy goals. Utilities are facing increasing pressures to invest in renewable energy technologies from both federal and state laws and requirements. Utilities being able to sell RECs to military installations, such as Fort Carson, helps improve the market for renewable energy and helps utilities meet their goals. Similarly, when an installation constructs a renewable energy plant, such as the solar plants on Fort Carson, Nellis AFB, and the one being built at Fort Irwin, it helps provide renewable energy and RECs that utilities can count toward their goals. For example, Xcel Energy bought Fort Carson's RECs from the post's 2-MW solar photovoltaic array, which helps this utility meet its 4 percent solar energy requirement by 2020 as required by the state of Colorado.

Help Advance the Smart Grid and Other Future Goals. Collaboration with installations can also help utilities advance toward their long-term goals, such as more "smart-grid" technologies that have the potential to improve the electric power grid's efficiency, reliability, and security. Experts state that new materials and information technologies hold the promise of enabling "more secure and robust systems operation, security monitoring, and efficient energy markets."¹⁶ Such technologies as smart meters and sensors will allow consumption to change based on real-time electricity pricing. Some utilities are trying to invest more in these smart meters, sensors, and other technologies that will facilitate such a future. When these utilities can help Army installations invest more in such advanced technologies, it benefits these utility goals. As will be discussed more in the next chapter, Army installations have not been doing this much yet, but it is another beneficial collaboration opportunity.

Help Meet Energy Security Goals. Just like military installations have interest in energy security, so do utilities. Utility companies want to ensure that they can supply efficient, reliable, consistent, and secure power that will not be disrupted by natural disaster, terrorist attacks, excessive peak demand, and other problems. Installations participating in demand response programs, reducing energy consumption through UESCs and other energy efficiency projects, and locating power generation plants on their installations help utilities in meeting their energy security objectives.

Public Image and Community Improvement Benefits. Lastly, utilities see value in collaborating with installations because of the community benefits and public image benefits. For example, we found that publicly owned utilities often appreciate the community benefit in helping reduce fossil fuel energy use by collaborating with installa-

¹⁵ *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

¹⁶ Massoud Amin and John Stringer, "The Electric Power Grid: Today and Tomorrow," *MRS Bulletin*, Vol. 33, April 2008, p. 403.

tions in UESCs, renewable energy, and other projects. Similarly, cooperatives see community value in helping reduce energy use and helping the Army installation become more efficient.

Barriers to Collaboration

Through our research and interviews with Army and other Service installation energy, legal, contracting, and other staff; utility company representatives; and ACSIM, IMCOM, PNNL, and others, we were able to identify barriers to installations implementing UESCs and collaborating with utilities as well as options for addressing these barriers. Below we explain each barrier, and in the following chapter we offer recommendations to overcome each barrier.

Utility Company Not Interested in Participating

Utility companies, utility associations, installation staff, and others stated a range of reasons why some utilities choose not to do UESCs with Army installations and other collaboration projects: lack of interest, insufficient staff, perception of risk in working with military installations,¹ length of the payback period, and perceived slow government processes. One barrier to installations collaborating with utilities is that some utility companies are just not interested in participating in UESCs. We found a variety of reasons for this lack of interest. For one, some utilities have no motivation or interest in saving energy. Sometimes this is due to a lack of incentive programs for utilities to save energy, which helps encourage UESC collaboration. Additionally, utilities sometimes choose not to participate in UESCs because staff do not have the knowledge or technical expertise necessary to facilitate them. Another staffing problem that discourages utilities from collaborating with installations is simply a shortage of staff time. Some utility company staff do not have the time available to commit to installation discussions and to establish a UESC or other collaboration projects. Also, utility companies tend to be risk-averse and see UESCs with the military as too risky. They have the same issue in collaborating in some renewable energy projects. Some are not comfortable with the ten-year payback schedule, thinking it too slow, while others

¹ An example of perceived risk is that the utility will invest a large amount of staff time in pursuing a UESC deal with an installation over a couple of years only to have the deal fall through, which has happened to at least one installation in the past.

want a longer one—especially if renewable energies are involved—since they often have longer payback periods. There is often the perception that there is too much federal “red tape” involved with a UESC, which discourages utilities from collaborating with installations. Some utility companies fear that the federal processes involved in establishing a UESC will be too slow to make the time investment or perceived risk worth it. Some have had this experience in the past. At one Army installation, the utility has been waiting for over two years for the installation contracting staff to approve the UESC contract, and at another the deal fell through after over a year of working together on a UESC.

Installation Energy Staff Issues

While we have touched on utility company staffing issues that may serve as barriers to installation collaboration, installations also experience energy staff issues that impede utility company collaboration. The most significant barrier that we identified is the lack of a qualified and experienced full-time energy manager. AR 420-1 states that IMCOM is responsible for ensuring that “each garrison has an Energy Manager appointed in writing and trained as required by current laws and Executive Orders to represent the organization in all energy and water matters.”² However, garrisons do not always have an appropriately trained or experienced energy manager to meet current energy requirements, especially given the current authorized pay grade level for this position. The highest GS level for energy-related installation positions is a GS-12 or equivalent. The lack of room for advancement beyond this level is thought to contribute to a relatively high turnover rate of installation energy managers. Experienced energy managers often leave their positions to move beyond the GS-12 ceiling because of better opportunities for advancement at other federal agencies and in the private sector. In fact, at the Fall 2008 FUPWG meeting we talked with two former Army energy managers, now at other federal agencies, who had left Army installation positions for this reason. In addition, a few interviewees stated that when the Veterans Administration started hiring energy managers at the GS-13 level, the Army lost some energy managers. When such experienced energy management staff leave, often a junior person comes on board and the Army loses important energy expertise, which makes it more difficult to collaborate with utilities in UESCs and other activities. As one interviewee pointed out, once energy staff leave, the UESC education process must begin again. In some cases, like Fort Irwin in 2008, installations have a hard time even filling the energy manager position. Many people we interviewed stated that energy manager staff turnover and lack of sufficient experience are serious issues. In addition,

² U.S. Army, “Army Regulation 420-1, Army Facilities Management,” Washington, D.C., Headquarters, Department of the Army, March 28, 2009, p. 289.

at a couple of installations, the energy manager retired, went to work for a contractor at a higher pay, and came back to the installation as a contracted energy staff member.

Even when there is a full-time energy manager at an installation, there is often not enough other trained energy staff to support him or her. Energy managers have many responsibilities and need additional qualified energy staff to meet installation energy management requirements, especially at larger installations. We found that there is not enough qualified energy staff in organizations with authority over installation energy issues, such as in the DPW. Larger installations often have numerous staff who have energy-related responsibilities, such as the HVAC maintenance and repair staff. These other energy-related staff, such as the installation utilities manager, also do not have the time to devote to the UESC development and implementation process, let alone other types of utility collaboration.

Additionally, installation energy staff also frequently lack the technical expertise or business experience required to implement a UESC, such as understanding the financing or the energy technologies being used. The financial, legal, technical, and contracting complexities of developing and implementing a UESC sometimes deter energy managers and staff from utility and installation collaboration. Energy staff are also often not aware of the ways in which utility companies can help them. As many experts noted, there is little visibility of, or information available, about UESCs and even less about working with utilities on other issues such as energy security, renewable energy projects, and taking advantage of USCs. Energy managers are also sometimes reluctant to commit to the payback term.

Legal and Contracting Staff Issues

In addition to energy staff issues, legal and contracting staff issues also present a barrier to installation and utility collaboration. Based on our interviews, this is the second most significant barrier to collaboration. We talked with numerous Army and other Service installation staff who stated that this is a main barrier in trying to effectively and efficiently develop and implement UESCs. In fact, many of these interviewees said that legal and contracting staff reluctance to participate in a UESC process can delay a project for months or years, which sometimes kills the effort. At one Army installation, the energy manager was quite frustrated because the UESC contract was passed from one contracting officer to another for two years before the contracting office told the energy manager that they did not have the staff to handle such a contract. Numerous other installation experts mentioned how long it took to educate and convince legal and contracting staff to support a UESC effort. This is also a barrier to other types of collaboration projects. A couple of installation personnel also noted that now that contracting staff are under a separate command, namely, Mission and Installation

Contracting Command (MICC), rather than under the garrison commander chain of command, it is even more difficult to get contracting support.

As with energy staff issues, legal and contracting staff suffer from a shortage of staff time to devote to UESC issues and a lack of technical expertise about the complexities of developing and implementing a UESC. There is often a general lack of knowledge and understanding of UESCs among legal and contracting staff, which is exacerbated by the limited visibility of, and limited information available, about UESCs. In fact, several experts pointed out that often such staff think that UESCs are not legal, mostly because UESCs do not need to be competed. Staff are also frequently reluctant to make the long-term commitment to the UESC, and sometimes this reluctance delays UESC contracts for months or even years.

Other Installation Support Issues

In addition to energy and legal and contracting staff issues, other installation support issues exist that act as barriers impeding utility and installation collaboration. First, Department of Public Works (DPW) staff often do not have the time or qualified staff to work with utilities and the installation energy staff on collaborative UESC, USC, renewable energy, energy security, or other projects. If the head of DPW has no knowledge of or interest in UESCs, it is very difficult for an energy manager to develop and implement one. For UESCs, interviewees also cited concerns about the complexity of UESC projects, and again, a lack of needed staff time and technical expertise.

Second, garrison commanders also frequently do not support, or lack interest in, utility collaboration. Garrison commander support is often needed to ensure that all relevant installation staff support the UESC process or other collaborative effort. If an installation wants to pursue a large-scale renewable energy project on post, like the Fort Carson solar array project, it needs to have support from numerous other installation organizations such as the financial, master planning, and environmental staff. Having garrison commander support shows these organizations that the energy projects are a priority.

The support of installation and other senior commanders of tenant units is also often needed to improve installation utility collaboration, especially because the collaboration project may affect buildings that soldiers are working in. If an installation wants to participate in a demand response program where the air conditioning will automatically be shut off for short periods during peak demand times in a certain building, it is important that the installation and senior commander of the units working in the building are on board.

Finally, financial and business installation staff are sometimes not interested in UESCs due to a reluctance to make a long-term commitment and investment and the financial complexities of implementing a UESC. Many UESCs and larger-scale renew-

able energy projects are large long-term complex investments, often over \$10 million in size and lasting for at least a decade. Such size aspects can turn off many installation business staff. Having the financial staff support and help in developing a UESC or a large-scale renewable energy project is usually a key part of the process. Like contracting staff, they can delay or kill a UESC process. Installation business staff also often do not have the exposure to, knowledge, training, or expertise to deal with UESCs or a large-scale renewable energy project. In addition, when they are brought into the process late—as they have been at some installations—the installation business staff are less likely to support it.

In general, installations are not aware of what utility companies can offer them and do not have enough information about UESCs and even less information about other collaboration opportunities. There are numerous problems related to a lack of education of various installation staff. At one installation, the information technology (IT) staff did not understand the need for and did not want to support a web-based EMCS system that was in the UESC project. Installation energy staff at another installation said that they had to spend a year just educating various installation people before they could really even get started in earnest with embarking on the UESC.

Renewable Energy Investment Issues

In addition to barriers to energy efficiency projects more generally, barriers specific to renewable energy projects also exist. First, there are barriers to renewable energy itself, such as economic issues. Low utility rates can make renewable energy projects seem like a less attractive financial investment. A couple different energy staff members at two different installations stated how it was difficult for their installations to invest in renewable energy projects because of low energy prices in their region and the lack of a state incentive program. Additionally, there is often more uncertainty and risk associated with renewable energy technologies. Because these technologies are newer and are not as established as more traditional energy efficiency projects, installation personnel may not feel comfortable taking on such a project, especially given the level of technical expertise needed to assess project details. For instance, one energy manager said he would like to pursue a renewable energy project, but felt he did not have the technical expertise to do so. The availability and reliability of renewable energy resources is also a concern.

In addition to these barriers, there are those specific to renewable energy collaboration. The ten-year payback limitation of the utility contracting vehicles generally used for UESCs often limits renewable energy collaboration, because renewable energy projects generally take longer to break even than efficiency projects do. A number of renewable energy experts and installation energy staff that were interviewed mentioned this barrier. Again, because most renewable energy technologies are relatively

new, some utilities will be less likely to take on the risk and invest in these less proven technologies.

Besides barriers, there are many opportunities for collaboration that are unique to renewable energy projects. Existing federal requirements for renewable energy and potential future climate change legislation motivates both installations and utilities to invest more in renewable energy activities. Additionally, within the 2008 federal stimulus bill and the October 2009 Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” there has been more federal emphasis on increased investments in renewable energy technologies. Some utility companies also want to do on-site power generation or an EUL deal using renewable energy projects, especially when they have renewable energy requirements in their state, as discussed earlier. Renewable energy projects also present opportunities to help meet some energy security goals. There are many state and local incentive programs and mandates that encourage renewable energy projects. Concerns about climate change are causing many state and local governments to impose more requirements on utilities as well as to provide more incentives for energy consumers to invest more in renewable energy technologies. In addition, an Army Corps of Engineers study identifies energy efficiency and renewable energy sources as the best options for meeting future energy requirements.³

Other Issues That Limit Successful UESC Implementation

Beyond the barriers already discussed, there are additional issues that limit successful UESC implementation, most notably, M&V and O&M issues. Without proper M&V and O&M, UESC (and ESPC) projects will not achieve the energy savings that were expected. If a project does not achieve the expected level of energy savings—or at least come close to it—the project will not be successful and can cost the Army a large amount of money without getting much of the benefits that were anticipated. Lack of building commissioning is also another issue with respect to achieving energy savings. We discuss each of these issues in more detail here.

Measurement and Verification (M&V)

M&V is important to ensure that the anticipated energy savings are being accrued and to detect maintenance and performance issues that need to be addressed to ensure the equipment is functioning properly to achieve the expected savings. However, M&V costs usually range from 1 to 10 percent of a project, so many installations are reluctant to include it in their budgets. Problems with M&V have been an ongoing issue

³ Eileen T. Westervelt and Donald F. Fournier, *Energy Trends and Implications for U.S. Army Installations*, U.S. Army Corps of Engineers, Engineer Research and Development Center, September 2005.

with both ESPCs and UESCs, which is part of the reason that ESPCs are required to include M&V while only rudimentary M&V is required for UESCs.⁴

Unfortunately, even when M&V is required, there can still be problems. For example, at one Army installation there have been ongoing problems with the ESPC contract implementation because the M&V by the ESCO is neither sufficient nor credible. Lack of knowledge of baseline energy use and insufficient metering have both contributed to this problem. One energy staff member referred to the ESCO's annual energy savings reports as "smoke and mirrors." We found that having a good baseline and appropriate metering in place for both UESCs and ESPCs is an issue at other installations as well. Many Army installations have buildings that were not individually metered in the past. Many times, a UESC or ESPC project includes installing energy meters. The result is that when the new energy efficient equipment is put in, there is no baseline energy use for that building from before the new equipment and energy meters were installed. Once meters are installed, they need to be monitored on a regular basis, and when problems are found they need to be reported and fixed to ensure appropriate M&V, which is not always the case.

Without proper M&V, other types of problems can arise as well. At another installation with an ESPC, as the "first responders" on service calls, the installation maintenance staff often are inclined to bypass the efficiency controls in order to make the tenants comfortable rather than wait for the ESCO to respond, thus causing actual energy savings to be much lower than the theoretical ones. If proper M&V was being conducted on a regular basis, this problem would have been discovered and hopefully corrected to ensure proper energy consumption savings.

Since it is not required for UESCs, M&V is often only done for one year, and some utilities are reluctant to continue it any longer. A couple installations' energy staff cited this lack of longer-term M&V as a barrier to implementing UESCs. They were afraid they would not get the energy savings and were reluctant to pursue a UESC.

Operations and Maintenance (O&M)

Some installations have also had problems with O&M. Without proper O&M, a building often will not operate at its peak performance and will not achieve the expected energy savings. At several different installations, energy staff that we interviewed noted that problems have occurred with O&M for UESC project equipment where installation staff are not properly operating or maintaining the equipment. This is sometimes due to staff lacking the training and expertise about certain systems to perform appropriate O&M. This problem also can be because O&M staff are expected to understand and maintain so many different types of equipment. As one former O&M staffer at

⁴ Note that EISA 07 requires minimal M&V for all energy projects, including UESCs, but it is not as extensive as what is generally written into an ESPC contract. However, according to ACSIM staff, recommendations for more expanded M&V will appear in the UESC guidance that ACSIM has developed, but not yet issued.

one installation told us, with MILCON projects the Army often chooses different equipment in each building, so there is inefficiency with respect to O&M staff training. Namely, O&M staff are not trained and do not have experience with all the different equipment. Staff also sometimes have problems getting parts, so instead they fix equipment without including the energy efficiency features, thus eliminating the energy benefits of the system. At one rural installation, staff said that since there is no local parts supplier for some of the newer, more energy efficient equipment, when equipment is down, there is significant pressure to get the system working ASAP. As a result, O&M staff do not wait for the part to come in and instead bypass the energy efficiency aspects of the equipment. The parts problem is also complicated when a post has many different equipment types and makers in different buildings.

Building Commissioning

The term “building commissioning” refers to a systematic quality assurance process that includes installing equipment, identifying and fixing problems, and training staff to ensure that they can operate and maintain the building.⁵ It is well known that commissioning new and existing buildings improves building performance and is very effective at identifying design, operation, and maintenance problems. Examples of problems identified by commissioning included improper installation and sizing of equipment and HVAC distribution, improper control systems configuration and sensor installation, improper scheduling of system operations, and deferred or poor maintenance procedures. Researchers at Lawrence Berkeley National Laboratory (LBL) have found that fixing these problems can save energy and improve worker comfort, mitigate indoor air quality problems, and increase the competence of in-house staff.⁶

LBL researchers’ analysis of building commissioning of over 600 commercial buildings found significant energy savings and other benefits. As shown in Table 4.1, they found that median one-time commissioning costs were \$0.30 per square foot for existing buildings and \$1.16 per square foot for new buildings. This led to median energy savings of 16 percent for existing buildings and 13 percent for new buildings. The median payback times were 1.1 and 4.2 years, respectively.⁷

However, Army installations, like many commercial builders and owners, are not taking advantage of this building commissioning process. As one expert on building commissioning says, it “remains an enigmatic practice whose visibility severely lags its

⁵ For more information on building commissioning, see U.S. Department of Energy (DOE), “Commissioning for Federal Facilities: A Practical Guide to Building Commission, Recommissioning, Retrocommissioning, and Continuous Commissioning,” undated.

⁶ Evan Mills, *Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions*, Report, Lawrence Berkeley National Laboratory, July 21, 2009, p. 2.

⁷ Mills, 2009. For examples of other benefits and energy savings from building commissioning, see Evan Mills and Paul Matthews, *Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects*, LBNL-1972E, Lawrence Berkeley National Laboratory, June 2009.

Table 4.1
Costs and Benefits of One-Time Building Commissioning for a Sample of
U.S. Commercial Buildings

	Existing Buildings	New Buildings
Median commissioning cost (\$/sf)	0.30	\$1.16
Median energy savings (percent)	16	13
Median payback times (years)	1.1	4.2
Median cost of greenhouse gas reductions (\$/tonne CO ₂ equivalent)	–110	–25

SOURCE: Mills, 2009.

potential.”⁸ Several Army energy experts we spoke to were frustrated because Army installations were not always able to perform building commissioning as part of their UESC process as they wanted to. Other Army staff not wanting to pay for building commissioning, and/or not being aware of the benefits, have been what often limits its use.

Broader Collaboration Issues That Are Not UESC-Specific

Beyond issues pertaining to UESCs, there are broader collaboration issues that should be addressed, including other collaboration opportunities where there has been less activity by Army installations but where there is great potential for utility and installation collaboration for mutual benefits.

The first issue is that there is a lack of knowledge about, or interest in, other non-UESC collaboration funding mechanisms that could serve as alternative or complementary funding vehicles to the UESC for energy projects at installations. These mechanisms include EULs, USCs, and PPAs. As discussed in the last two chapters, these mechanisms can be very effective tools to help facilitate installation and utility collaboration in a range of energy projects from solar parking lot lights to large-scale on-site power generation projects. However, we found that many installations and utilities have little knowledge or experience in these areas. One energy manager stated that these mechanisms sounded promising, but he did not really know much about them and did not have time to learn about them. Not much information is provided to installations or utilities about these opportunities. We also found barriers that make it difficult to use some of these mechanisms, such as the EUL. One installation had problems trying to use an EUL for a large-scale energy project because of dealing with Army real estate staff who manage EULs. Often, Army real estate staff view the EUL as a real estate deal rather than an energy project and are concerned about the Army

⁸ Mills, 2009.

making a profit, while the installation staff are focused on the energy benefits. In this example, ACSIM real estate staff did not want to approve the project because they felt that the financial return was not high enough. ACSIM energy staff worked with them to get the deal through. In another case, the energy manager ran into problems trying to use a power purchase agreement with an EUL.

Beyond these mechanisms, there is not much activity in other collaboration opportunities that could be done with or without a UESC, including on-site power generation, energy security, metering and smart grid, and demand response and other incentive programs. Utilities would like to see more Army installations participating in such programs because of the benefits discussed in the previous chapter. However, such activities are not being pursued by many installations. We briefly discuss some of the barriers for these types of projects.

As discussed earlier, on-site power generation is an area where both installations and utilities have interest in collaborating, especially regarding renewable energy power. However, both utilities and installations lack information about how to arrange such deals. There are often significant legal, financial, environmental, technological, contracting, and real estate issues that need to be addressed to develop and implement such projects, which can discourage installations, especially ones with less experienced energy managers, from even pursuing them. Fort Carson experienced many of these challenges in developing and implementing its solar array project (see the Fort Carson appendix for more details). The barriers just discussed regarding EULs and PPAs are other examples. The 10-year payback period with the typical UESC contracting vehicle is a barrier to using this tool for on-site power generation deals.

Energy security projects is another area where both installations and utilities want to collaborate for mutual benefit. Both organizations are concerned about ensuring consistent reliable power, especially given potential terrorist attacks, natural disasters, aging infrastructure, and other problems that can affect the power grid. Main barriers here include lack of interest, information, knowledge, and time by both installation and utility staff to pursue such deals. Since backup generators and systems are already in place, many installations' staff may not feel a need to address such issues, assuming existing systems are adequate, not necessarily aware of new directives and findings regarding energy security concerns. For example, a 2008 Defense Science Board study recommended that installations be prepared to endure a prolonged power outage of at least six months and take steps to ensure continuity of operations during this time.⁹ Technical issues and choices about what are the most appropriate forms and systems for backup power, energy storage, and distribution systems and how much risk an installation is willing to take make it difficult for installation staff to develop projects.

⁹ Defense Science Board, *More Fight—Less Fuel*, Defense Science Board Task Force on DoD Energy Security, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, Washington, D.C., February 2008.

Such issues can discourage some staff, especially inexperienced energy managers, from even pursuing such projects.

Metering and smart grid collaboration is another area of mutual interest. Many utilities are motivated to help installations have appropriate metering because it is so important to their business. Utilities have expertise in metering and ways to help installations install meters despite budget problems, but installations are not aware of such opportunities. One utility mentioned how one installation had a contractor installing meters that were not the most appropriate type, whereas the utility could have saved the installation money and had better meters installed, but the installation did not think of discussing such investments with the utility. Utilities also want installations to install more smart meters and start thinking about deploying smart grid systems, e.g., monitoring systems that keep track of all electricity flowing in the system and provide feedback. However, many installations are not even thinking about such technologies and are just trying to get basic meters installed. Given the installation staffing issues and Army energy requirements, there are real technical, expertise, time, and other priority issues that the Army is dealing with that limit interest in these areas. However, the utility industry is moving ahead in these areas and the Army needs to be involved for its long-term benefit. It is important to note that some utilities also lack knowledge and time to pursue smart grid-type collaborations.

Lastly, utilities would like installations to participate more in their demand response and other incentive programs. There are untapped opportunities in demand response economic programs, demand response participation in capacity markets, dynamic/real-time pricing, and automated demand response, which is triggered automatically by an external signal. Currently, military installation participation has been low, often because it is difficult for installations to directly reap the financial proceeds from demand response participation. If a utility gives an installation a refund check, it must go into the federal government general fund rather than to the installation energy program. Such problems exist with other energy incentive programs. Staffing issues and lack of time, knowledge, and interest also limit installation participation in demand response programs and other incentive programs.

Recommendations to Address Barriers

In the last chapter we identified barriers to installations collaborating with utilities. In this chapter we provide recommendations on how the Army could address such barriers to increase the success of Army installation and utility collaboration for mutual benefits. These recommendations are based on our interviews of Army and other Service installation, energy, legal, contracting, and other staff; utility company representatives; ACSIM, IMCOM, DOE, PNNL, and other relevant experts; and our review of relevant literature and installation documentation. In this section we go through each of the barrier areas discussed in the last chapter, and then we provide high-priority recommendations that address multiple barriers. The chapter ends with overall conclusions.

Motivating Utilities to Collaborate with Installations

Through interviews with utility associations, utility companies, and other experts in the field, we were able to identify potential solutions to overcome the barrier of insufficient utility interest in collaborating with installations and participating in UESCs. These solutions fall into four main categories: (1) promote more direct outreach and collaboration with utilities, (2) provide more education to utilities, (3) allow a longer payback period for UESCs, as long as 30 years or more, for greater flexibility, and (4) try to speed federal processes where possible.

Promote More Direct Outreach and Collaboration with Utilities

Utility companies can be motivated to collaborate with Army installations more by having the installation start a dialogue with the utility. To further this effort, ACSIM and IMCOM should have a policy on installation outreach to utilities about collaboration for mutual benefit. Such a policy might state that installations should discuss collaboration opportunities with their utilities at least once a year. The installation can be proactive and establish an ongoing positive relationship with the utility and express the desire to collaborate through a UESC. This can encourage the utility staff to consider exploring a UESC with the installation and begin educating themselves on the process. As one knowledgeable DOE representative pointed out, often an Army instal-

lation is the largest customer of a utility, and the utility values this relationship. So an installation just expressing interest in doing a UESC can help start the process. Also, ACSIM, IMCOM, and other commands should engage more with utility associations to increase UESC awareness. In this vein, ACSIM staff met with representatives from EEI, the association of U.S. investor-owned electric companies, in June 2008 to discuss areas of mutual interest such as energy security, demand response, and UESCs. Utility representatives have found such meetings valuable. Finally, where needed, ACSIM, IMCOM, and other commands should encourage a utility that is working successfully with an installation on UESCs to talk with a utility reluctant to collaborate. Hearing a success story from the perspective of another utility may be all it takes to get it engaged in collaborating with its local installation.

In states lacking specific renewable or energy efficiency policies and incentives (such as RPSs or efficiency tax credits), Army installations may need extra assistance in motivating utilities to participate in partnerships with installations. ACSIM and FEMP could help provide such assistance. The business case for such collaborations may be less obvious in these cases, but can often nevertheless be made. In these cases, the installation staff may also need to take the initiative more.

Provide More Information to Utilities About UESCs

ACSIM, IMCOM, and other Army commands should also do more to provide education about UESCs to utilities by working with FEMP and PNNL to have them help provide such education. One way in which utilities can become educated on UESCs is through FEMP outreach. FEMP provides online training about UESCs that utility companies can take advantage of, and FEMP staff will explain the advantages of UESCs to utilities. If utility companies do not have technical staff to help facilitate UESCs, PNNL can help provide technical assistance. PNNL can provide services such as recruiting utilities that have not participated in UESCs in the past, providing sample contract vehicles to the utility company to help eliminate contracting hurdles, and evaluating the technical viability of a project. IMCOM has already hired PNNL to provide such UESC assistance to Army installations and their utilities. Installations have found this useful both to help educate utilities and to encourage them to do UESC projects. Such assistance should be continued.

Utility companies reluctant to collaborate with installations could also benefit from the Army establishing a standard briefing that details the advantages that UESC participation provides to utilities. ACSIM and IMCOM should put together such a briefing and ensure utilities see it by presenting it at utility conferences and to selected utilities and providing it to associations for them to show to their members. FEMP and PNNL staff could help in developing and presenting such a briefing. ACSIM staff have already presented a similar briefing at a utility conference in 2009. Such activities should be continued and expanded on.

Allow Longer Payback in UESCs, at Least 30 Years

To address barriers related to the short UESC payback period in the contracting authority, UESC contracts should be allowed to be as long as 30 or even 40 years. This payback extension would allow greater flexibility, such as incorporation of renewable energy projects. Obviously, the payback should be based on what makes sense for the individual installation's needs. For example, in cases where the longevity of a structure is in question, these longer-term paybacks would not be advisable. Contracts could still be done for shorter periods, such as 10- or 15-year payback. For instance, a shorter-term UESC contract would be better suited for low-risk, quick-payoff efficiency measures. Extending the contract length allows the installations and utilities to use what payback makes the most sense for their situation.

An Army legal expert we interviewed explained that the limit in the contract period (which limits the payback period) falls under the statutory authority of General Utility Authority (40 USC 501, 1949), which is a 10-year authority. This gives the authority to "buy utilities' services," and since energy conservation and management was determined to fall under this definition, this authority is used to apply to UESCs. The current UESC authority, 10 USC 2913, does not include any language about a 10-year payback term. However, the 2009 Army legal interpretation was that because the statutory authority requirement for the contract is limited to 10 years, it in turn limits a UESC's payback term to 10 years. The Army legal expert we spoke to said that to extend the UESC payback term, a statutory proposal must be submitted before Congress, making it a government-wide solution, that would need to either (a) change the language in the General Utility Authority (40 USC 501) to extend the contracting authority to 30 years (or some other amount) or (b) change the language in the UESC authority (10 USC 2913) that allows for sole-source contracting up to a specified amount of years, such as 30 years. The key is to change the length of the contracting authority.

Speed Up Federal Processes Where Possible

In general, the federal process for a UESC should be streamlined as much as possible to speed up UESC implementation. This would help address utility companies' concerns that the military takes too long to develop and implement UESCs. As was discussed in the previous chapter, there are numerous reasons that a UESC process can be slowed, including the reluctance and need to educate garrison commander, DPW, contracting, legal, and financial staff. If these issues can be addressed as soon as possible with the recommendations suggested in other parts of this chapter, it will help speed the process of developing a UESC. Addressing key roadblocks, such as the often slow contracts approval process, will help significantly in speeding this process.

Alleviating Energy Staff Issues

Based on our interviews and analysis, we identified several options to address the barriers presented by energy staff issues. These options fall into four main categories: (1) ensure sufficient energy staff and for large installations raise the pay grade of the energy manager, (2) provide policy and a handbook on how to do UESCs, (3) provide more training on UESCs and other utility collaboration opportunities, and (4) provide more technical assistance to installations.

Ensure Sufficient Energy Staff and for Large Installations Raise the Pay Grade of the Energy Manager

Having a full-time energy manager with energy management training on staff at each installation would solve many issues with lack of staff time and expertise. For the largest installations, this position should also ideally be offered at the GS-13 level to lessen the frequency of staff turnover and ensure that qualified people stay in the position given the commercial marketplace for qualified energy managers. Many of the people that we interviewed felt this was one of the most important things to do to help improve utility/installation collaboration and for implementing UESCs. Our review of installations' energy management history and experience supported this recommendation as well. It is difficult to implement UESCs and other utility collaborative projects and have an innovative and effective installation energy program without qualified and experienced energy management staff.

We recognize that requiring a GS-13 position for an Army energy manager even at the largest installations would be difficult, especially given current budget constraints and other current Army energy position levels through headquarters staff. There needs to be a requirement issued by the Deputy Chief of Staff, G-3/5/7, Headquarters, Department of the Army authorizing a GS-13 (or equivalent level in the new system) for the installation energy manager position. However, the G-3/5/7 will not issue such a requirement without a manpower study showing that it is needed. ACSIM and/or IMCOM should conduct such a study to analyze and confirm this need and work with the G-3/5/7 and other Army organizations to make it happen. Given the numerous energy-related goals and objectives that large installations are required to meet and the numerous installation energy-related initiatives and responsibilities going well beyond the utility collaboration activities discussed in this report, the largest installations should ideally have an energy manager at the GS-13 level.

To help address the shortage of energy staffing, installations should also employ one or more Resource Efficiency Managers (REMs) to supplement energy management staff as much as possible. REMs serve as contractors who work for the government, in this case the Army, and are effectively paid by the Army through a contracting mechanism, such as a UESC, generally with self-generated energy-related savings as stipulated in the contract. REMs often have good experience, training, and techni-

cal expertise that they can bring to energy efficiency projects. Part-time REMs can be shared with other installations or organizations and bring experience from these other activities. Many Army installation staff that we spoke to, as well as utility representations and staff at Navy and Marine Corps bases, mentioned the benefits of having full- or part-time REMs helping with the installation energy program and UESCs. REMs would complement existing installation energy staff.

At larger posts, additional energy staff are usually necessary as well. The Army needs to ensure the presence of sufficient energy staff at its installations not only for utility collaboration, but also to enable the Army to meet all its other energy goals. This need was also highlighted at the Sustainability In-Progress Review (IPR) held at Fort Bragg, January 12–14, 2010.

Provide Policy and Handbook on How to Do UESCs

ACSIM should provide installations with a policy and handbook detailing how UESCs should be implemented. Many installation staff thought this would be useful. A UESC policy and handbook would facilitate the education of installation energy staff and better prepare them to utilize UESCs. The draft UESC policy that ACSIM developed in 2009 is a good first step.¹ This policy should be issued and distributed widely throughout the Army. A more detailed UESC handbook is also needed, similar to the Army Policy Guidance for the Implementation of an ESPC. It should provide detailed installation case study examples of how to successfully implement UESCs, including addressing lessons learned from previous experiences and samples of the actual UESC contracts. The case studies in the appendixes of this report on Fort Campbell and Fort Knox could be expanded upon and used in such a handbook. In addition to information about UESCs, a broader handbook for new energy managers covering a range of installation energy issues, including financing mechanisms and energy security, would be useful for helping new energy managers get up to speed more quickly.

Provide More Training on UESCs and Other Utility Collaboration Opportunities

In general, installation energy staff need to receive more training and education on UESCs and how to collaborate with utilities. ACSIM, IMCOM, and other commands should help fund travel so that energy staff can attend UESC workshops often hosted by FEMP and the FUPWG conferences to receive such education. They have done some of this in the past and should continue to do it. Special sessions at GovEnergy could also be held to provide installation energy staff with UESC implementation training. ACSIM and IMCOM have worked with FEMP and GovEnergy organizers in such areas. One such activity that should also be continued is ACSIM/IMCOM

¹ For presentations by ACSIM on this policy, see Randy Smidt, “Army Policy Guidance for Utility Energy Services Contracts,” presented at the Federal Utility Partnership Working Group, May 5, 2009, and Randy Smidt and Amy Solana, “Army Policy Guidance for Utility Energy Services Contracts,” presented at the Federal Environmental Symposium, Bellevue, Washington, June 2–4, 2009.

working with FEMP to ensure that UESC workshops are held in locations near large Army posts to help minimize travel costs and facilitate greater installation participation in the workshops.

ACSIM and IMCOM should also encourage installation staff to network and share information across installations, such as providing conference calls and Internet mechanisms for sharing information on key topics including UESCs, other financial mechanisms, on-site generation, demand response, and energy security. In fact, as is discussed in the Fort Campbell case study in Appendix A, energy staff networking across installations was instrumental in Fort Campbell starting to implement UESCs. The energy manager at Fort Campbell had spoken with the energy manager at Fort Knox about his UESC program and liked what he heard. He then had a representative from Fort Knox make a UESC presentation at a Fort Campbell energy planning workshop.

Provide More Technical Assistance to Installations

In terms of addressing the lack of knowledge or technical expertise of energy staff, more technical assistance could be provided to installations through organizations such as PNNL, which currently assist in installation and utility collaboration. IMCOM should continue to sponsor PNNL's assistance to installations in starting, developing, and implementing UESCs. Army headquarters staff could also help provide technical teams to assist installation energy staff. For instance, the Energy Security Tiger Team that was brought together at Fort Bliss in February 2009 provided outside assistance to the post's energy staff. This team brought together energy, engineering, and program management experts from the Deputy Assistant Secretary of the Army for Energy and Partnerships [DASA(E&P)], ACSIM, IMCOM, USACE, DOE, DOE labs, Fort Bliss Directorate of Public Works, and other organizations to "recommend opportunities to improve energy services, efficient energy use, and energy security without compromising mission requirements while also recognizing environmental constraints."² Given the manpower and time investments, such Tiger Teams can be expensive, but it is another option that several interviewees thought is needed.

Improving Legal and Contracting Staff Issues

Again, as with energy staff issues, education is the key to overcoming the legal and contracting staff issues that serve as a barrier to UESC implementation and other types of collaboration. Numerous utility representatives and installation staff from all of the Services who had implemented UESCs said that education and sometimes assistance

² Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, *Energy Security Tiger Team Assessment—Fort Bliss, Final Report*, Washington, D.C., April 14, 2009.

were needed. For example, at Fort Lewis, initially the contracting and legal staff were reluctant to do a UESC because of their lack of familiarity with this type of agreement. But with ongoing outreach, education, and coordination, Fort Lewis energy staff were able to overcome this barrier and to have the contracts staff support the UESC process.

Based on the feedback from legal and contracting and other installation staff, as well as utility representatives, we identified three categories of options to address this barrier: (1) provide legal training regarding UESCs within standard Army legal educational venues, (2) provide UESC training directly to installation contracting and legal staff, and (3) assist reluctant and overworked contracting staff.

Provide Legal Training Regarding UESCs Within Standard Army Legal Educational Venues

A couple of legal staff members who were interviewed felt the best way to address the education issue is to better integrate UESC legal training into standard courses that legal staff take. First, UESC training should be included in the Judge Advocate General (JAG) school classes. It was reported that the basic JAG school course contains a quick overview of ESPC, UESC, and PPA contracting mechanisms. However, the UESC material should be reviewed and expanded as found appropriate. The material should also discuss other collaboration opportunities. Other legal training to assist installation contracting staff in UESC implementation could include having UESC training in the annual environmental course, including UESC issues as part of contracting legal courses, or including it at the Government Contract Law Symposium. Such training modifications could be achieved through ACSIM approaching and working with headquarters legal and contracting staff, such as relevant staff at MICC headquarters.³

Provide UESC Training Directly to Installation Staff

ACSIM, IMCOM, MICC, and other relevant commands should help facilitate a process of installation legal and contracting staff receiving more information and training about UESCs. According to our interviews and analysis, there are four main activities they could do to help. First, legal contracting staff could attend UESC workshops to learn more about utility collaboration. Such attendance can be difficult given the travel and time commitments, though, as mentioned earlier, this can be eased by having the workshop located near the installation. ACSIM and IMCOM should reach out to MICC to get it to encourage and support more installation contracting staff attending UESC training. Second, the new UESC policy should include a section that explains the role of installation contracting officers and mention the specific legal language and documents that authorize UESCs. This policy should be provided to installation contracting staff through official MICC channels, as well as by installation energy

³ It should be noted, as will be discussed later, that USACE Huntsville and DLA-Energy are also providing contract administration on UESCs now as well as MICC.

staff. Several installation staff said just being able to point to such language in an official Army policy would help. Third, a more detailed UESC handbook should also be developed and provided to legal and contracting staff. Fourth, FEMP has developed contractor training regarding UESCs, and installation contracting staff should attend this training. ACSIM and IMCOM should work with MICC to ensure that Army contracting staff at all levels attend this training.

Assist Reluctant and Overworked Contracting Staff

Contracting and installation staff felt there are several things that could be done to address the fact that the contracting staff on many installations are too busy and reluctant to work on UESCs. First, interviewees felt a Center of Expertise on UESCs should be established within the Army Headquarters contracting office, i.e., at MICC headquarters. This center would serve as a resource to installation staff and could refer inexperienced installation contracting staff to counterparts at other installations who do have UESC experience. With specific regard to legal confusion, legal staff at one installation did not know who to go to for legal advice on UESCs and noted that there was no centralized resource for legal advice regarding UESCs. The staff compared this situation to the availability of environmental JAG-level advisors who they can contact on specific topics (e.g., air, water) when they need advice in the environmental area. An equivalent person or people serving as a clear legal resource on the topic of energy in general and UESCs in particular would be helpful.

Another suggestion was to have the help of UESC-trained contracting staff available at Defense Logistics Agency–Energy and USACE Huntsville, which administers ESPC contracts. A couple of installations are already using USACE staff from Huntsville to help with UESC contracting. However, one installation energy manager pointed out that this costs them additional money since USACE charges them a fee. This person also noted that there could be issues with these organizations having enough staff time to help. However, MICC staff, in some cases, also charges now. In fact, MICC staff has stated that for any UESC/ESPC new starts that were not included in their budget, they will now have to charge for contract administration services.

A third option to help address the subject issue is to refer installation contracting staff to another installation's contracting staff member who has UESC experience. A contracting officer who has just helped to complete a successful UESC agreement can often effectively assist another contracting officer in this process. A number of installations, including Army as well as other Services and utility representatives, said this would be a useful way to help contracting staff support a UESC.

A fourth option, where appropriate, is that contracting staff should be referred to ACSIM/IMCOM energy offices and/or PNNL to provide technical assistance. ACSIM/IMCOM energy offices might also be able to refer the contracting staff to appropriate MICC staff to help out as well. Given their work with other Army installa-

tions, PNNL has sample contracts and other UESC process experience that they could provide to installation contractors.

Addressing Other Installation Support Issues

To attempt to overcome the other installation staff support issues, we have identified options to address the related barriers and have grouped these options in four main categories: (1) increase education and visibility about UESCs, (2) have UESC/utility collaboration/energy training in commander's courses, (3) provide DPW staff with more resources and knowledge, and (4) educate financial and business staff about UESCs.

Besides these recommendation areas, many experts we interviewed stated that many of these issues with other staff could be mitigated or more easily addressed by having a full-time experienced energy manager and involving these other staff early in the process.

We also found that there are benefits and synergies between an installation's sustainability program and its energy program, which can help address some of these staffing issues. Often a sustainability program includes key energy goals and objectives, and it can both help provide staff support and educate and motivate staff to support utility and energy collaboration, such as helping provide commander support. It also helps when there are staff shortages in the energy program. Such synergies have occurred at Fort Lewis and Fort Carson. At Fort Lewis, when the energy management position was unfilled for a while, having an active sustainability program that included a focus on energy helped provide needed support and expertise for the energy program, including garrison commander support.

Increase Education and Visibility About UESCs

ACSIM and IMCOM and the other commands should increase information and education about UESCs and utility collaboration by finalizing, issuing, and widely distributing the ACSIM UESC policy that was drafted in 2009. Numerous installation energy managers and other staff we interviewed felt that having a UESC policy they could hold up and show to other organizations on the installation would be very useful to help get the support of these other organizations. ACSIM, in collaboration with other commands, should also develop a UESC handbook to provide more detailed "how-to" examples about implementing successful UESCs and the benefits to the installation. Detailed case studies are needed to show how utility collaboration helps the installation save money, reduce energy consumption, improve installation operations, and improve energy reliability and security. IMCOM can help provide these case studies. Installation interviewees thought this could also help them gain wider support of their UESC efforts.

Have UESC/Utility Collaboration/Energy Training in Commander's Courses

Interviewees also stated the importance of getting basic energy, UESC, and utility collaboration information into garrison commander and installation and other senior commander classes. Such education would not have to be extensive, but should expose such senior leaders to the basic concepts and why they are important to the Army's mission. Commanders should be taught about the importance of installation energy goals and how UESC and other utility collaboration can not only help meet them, but save money and be important to the continued operation and sustainability of the installation mission by ensuring long-term reliable power. ACSIM/IMCOM and the other commands should ensure that appropriate training is included in the Garrison Commander's course. ACSIM should explore with the G-3/5/7 and the Army's Chief of Staff how best to implement such training in the installation and other senior commanders' education process.

Provide DPW Staff with More Resources and Knowledge

DPW staff should be provided with more resources and knowledge to better understand and implement UESCs. Key DPW staff, such as the DPW director, should be encouraged by ACSIM and IMCOM to attend UESC workshops, FUPWG conferences, and relevant GovEnergy sessions to gain UESC and utility collaboration knowledge. ACSIM and IMCOM can also help provide collaboration technical assistance, such as leveraging PNNL's UESC assistant activities. PNNL should also provide relevant DPW staff with technical assistance, as they do with the energy manager and other installation staff. DPW staff shortages in areas with energy responsibilities should be addressed to allow ample staff time for UESC implementation and other utility collaboration activities.

Educate Financial/Business Staff About Utility Collaboration

Installation staff also stated that financial and business staff should be offered more training on UESCs and other utility collaboration opportunities. ACSIM, IMCOM, and other relevant commands should encourage and help provide travel funds so such staff could attend UESC workshops, FUPWG conferences, and/or GovEnergy sessions. As suggested before, working with FEMP to locate UESC training near large installations would help in this process. ACSIM, IMCOM, and other Army commands should also provide training about energy financing mechanisms and provide staff with business case studies regarding utility collaboration. They could provide detailed case studies about the business benefits, financial processes and issues in the Fort Knox UESC activities, Fort Carson solar array collaboration, and other relevant examples. In addition, financial and business staff should be involved earlier in the UESC and other utility collaboration processes so that they more fully understand and become a part of them.

Renewable Energy Investment Issues

In the previous chapters we have discussed some of the barriers, as well as the benefits and opportunities, for installations and utilities with regard to collaborating on renewable energy projects. We have identified several specific recommendations that ACSIM, IMCOM, and other parts of the Army should take to address the barriers and better take advantage of these renewable energy opportunities. They fall into the following categories: (1) encourage, support, and document more renewable energy experiments at installations, (2) expand installation staff education and training, (3) allow a longer payback period for UESCs, as much as 30 years or more, and (4) improve collaboration with utilities in renewable energy through Army policies and guidance.

However, before discussing these specific recommendations, we briefly discuss some general trends regarding renewable energy technologies and markets that the Army needs to keep in mind. Renewable energy capacity in the United States has been growing and is expected to continue to grow. For example, wind is the largest component of U.S. no-hydro renewable generation (25 of 42 GW in 2008), and 8,545 MW of new wind capacity was added in 2008, a 51 percent increase from 2007.⁴ As this capacity grows, the risks and costs of the technologies will decrease and performance will improve as innovation takes place and more of these technologies are developed and implemented. Such benefits have already started to occur with solar photovoltaic power, where innovation and capacity expansion continue to lower the costs of implementing this technology.⁵ Traditional energy sources will continue to provide most U.S. energy, but renewable and biofuels use will accelerate.⁶ In addition, worldwide and U.S. energy demand will increase, which will likely cause overall energy prices to increase, making renewable energy technologies more cost-competitive. Global energy demand is expected to grow almost 50 percent by 2030,⁷ and U.S. energy use is expected to grow 12 percent by 2030.⁸ Given February 2010 laws, energy prices are projected to gradually increase until they exceed 2006 energy prices by 5 to 10 percent in 2030,⁹ but these are likely to be even higher if any type of climate change legislation passes. The Army needs to consider such trends when making investments today and

⁴ Ryan Wiser and Mark Bolinger, "2008 Wind Technologies Market Report," U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, July 2009.

⁵ Richard Silbergliitt, Anny Wong, S. R. Bohandy, Brian G. Chow, Noreen Clancy, Scott Hassell, David R. Howell, Gregory S. Jones, Eric Landree, and Parry Norling, *The Global Technology Revolution China, Executive Summary: Emerging Technology Opportunities for the Tianjin Binhai New Area (TBNA) and the Tianjin Economic-Technological Development Area (TEDA)*, Santa Monica, Calif.: RAND Corporation, MG-776-TBNA/TEDA, 2009.

⁶ EIA, *Annual Energy Outlook* (AEO) 2009, Figure 37.

⁷ Energy Information Administration (EIA), *International Energy Outlook* (IEO) 2009, Table A1.

⁸ EIA, AEO 2009, Figure 36.

⁹ EIA, AEO 2009 with ARRA, Tables 8 and 13.

recognize that renewables will become increasingly cost-effective and important in the future.

Encourage, Support, and Document More Renewable Energy Experiments at Installations

ACSIM, IMCOM, and other Army commands should encourage and support efforts for renewable energy experiments at installations. Such support needs to include research, financial, and technical assessments regarding what are the most feasible, productive, and cost-effective renewable energy resources for a given installation given its location and available renewable resources. A good example is the Army providing PNNL support to do renewable energy studies at installations such as Fort Bliss and Fort Lewis. At Fort Bliss, IMCOM provided support for PNNL researchers to do a technology assessment to identify the available renewable energy opportunities at this installation.¹⁰ Similarly, the USACE funded an energy optimization assessment at Fort Bliss to assess cost issues associated with such renewable energy technologies.¹¹ Then, the Army's Fort Bliss Tiger Team effort in February 2009 brought together external technical experts and installation staff who used these reports to help identify the renewable energy investments that would be the most viable given mission, environmental, business, and other local installation conditions. Such Army support also needs to include not only helping installations address policy, regulatory, and financial hurdles, but actually implementing large-scale renewable energy projects. The Fort Irwin and Fort Carson on-site solar power generation projects are good examples where ACSIM and IMCOM have been supportive and have helped installations implement projects. Such support needs to be continued and expanded to other installations throughout the Army.

Both small- and large-scale successes at actually implementing renewable energy projects should be documented so that the installation can try the renewable energy project on a larger scale, or so other installations could try similar renewable energy projects. Especially for the larger and more complex projects, such documentation should include in-depth case studies (not just one- or two-page descriptions) and should discuss the process of assessing and implementing the renewable energy project, provide lessons learned, and include the barriers encountered and how they were overcome. ACSIM/IMCOM should help installations document these successes.

¹⁰ For the details on this study, see W. D. Chvala et al., "Renewable Energy Opportunities at Fort Bliss, Texas," PNNL, U.S. DOE, PNNL-18169, January 2009.

¹¹ For the details on this study, see David M. Underwood et al., "Energy Optimization Assessment at U.S. Army Installations: Fort Bliss, Texas," CERL, USACE, Champaign, Ill., September 2008.

Expand Installation Staff Education and Training

ACSIM, IMCOM, and other relevant Army commands should increase efforts for staff education and training with regard to renewable energy and how to implement projects. More conferences and workshops should be planned, funded, and attended by installation energy staff. For instance, in July 2008, the Army funded PNNL to host an Energy Summit in Richland, Washington with the theme “Moving Forward with Renewable Energy.” Installation energy managers and other staff attended the summit and increased their awareness of renewable energy options. Helping fund installation energy staffs travel to such workshops and other relevant DOE, regional, and national conferences, such as GovEnergy, is another important role for ACSIM and IMCOM given installation funding limitations. ACSIM/IMCOM should also be sure to refer installation energy managers to FEMP as a useful educational resource.

ACSIM/IMCOM should also help facilitate more networking across installations so that energy managers can exchange information on renewable energy technologies. Besides conferences, they could have conference calls, SharePoint sites, or other Internet-based collaboration forums to help installation staff network about renewable energy. ACSIM or IMCOM could institute monthly conference calls on different renewable energy topics such as wind power and solar power, financial issues in trying to do renewable energy projects, collaborating with utilities in renewable energy projects, etc.

Additionally, as just discussed, ACSIM or IMCOM should provide in-depth “how-to” case studies for renewable energy projects. Several energy managers that we spoke to expressed a need for real implementation help on a step-by-step basis. They want details on how installations that have implemented projects were able to address key barriers—such as financial issues or lack of installation technical expertise—to successfully implement a project. Extensive case studies would help share such details across a wide range of installations.

Allow Longer Payback in UESCs

As stated previously, renewable energy projects are extremely limited by the 10-year UESC contract limit, which limits the payback to 10 years, and thus are generally funded by alternative methods. Extending the UESC contract limit to 30 or even 40 years would allow more time for renewable energy projects to show savings and be more financially feasible. Numerous experts we spoke to felt this is needed to make UESCs a more feasible option for implementing renewable energy projects.¹² Earlier in this chapter, we discussed the steps necessary to extend the UESC term.

¹² It is important to note that there may be reasons that some renewable technologies are better suited to other financing mechanisms in some situations, such as a PPA used to finance (relatively expensive) solar photovoltaics so that it can be more broadly competed than a UESC.

Improve Collaboration with Utilities in Renewable Energy Through Army Policy and Guidance

Army policy and guidance should encourage more on-site power generation, PPAs, and EUL deals regarding renewable energy technologies. ACSIM should develop installation renewable energy policy guidance, like the draft UESC policy, that includes a discussion of the importance of such tools for collaborating with utilities in renewable energy projects. Besides helping improve utility collaboration with installations in renewable energy, such policy guidance is needed to help installations reach the Army's renewable energy goals. ACSIM and IMCOM should also develop an enterprise approach to renewable energy investments that addresses economy-of-scale issues across installations and incorporates this into the renewable energy policy guidance. Additionally, through policy and guidance, ACSIM, IMCOM, and other relevant commands should encourage more energy security collaboration that takes advantage of renewable energy technologies where possible. Army policy should also state that installations should take advantage of federal, state, and local renewable energy incentive programs where they can, even if only for initial pilot experiments. A good example is applying for DOE technical grants and assistance in renewable energy as Fort Bliss has done. Fort Bliss received \$675,000 in funding toward implementing the Tiger Team recommendations on renewable energy investments.¹³

Addressing Other Issues That Limit Successful UESC Implementation

We have identified two main options to address problems with lack of sufficient M&V, O&M, and building commissioning limiting successful UESC implementation: (1) the new UESC policy should ensure appropriate M&V, O&M, and building commissioning, and (2) the new UESC handbook, recommended above, should provide examples of successful M&V, O&M, and building commissioning.

UESC Policy Should Ensure Appropriate M&V, O&M, and Building Commissioning

In terms of M&V, ACSIM should ensure that the new UESC policy requires M&V planning that goes beyond the first year in order to ensure UESC project success over time. Installation staff or the utility should do periodic M&V assessments. Appropriate M&V can be built into the UESC contract or conducted by the installation. What is considered appropriate should be based on the technology being implemented and the resources available. Fort Campbell's approach to including different types of M&V that vary depending on the equipment type as part of its UESC is a good model (see the M&V discussion in the Fort Campbell case study in Appendix A). In addition, the

¹³ MG Howard B. Bromberg, Commanding General, Fort Bliss, Texas, "Fort Bliss Energy Program," AUSA presentation, October 6, 2009.

policy should state that good baselines must be established in order to show true energy savings. UESC projects should also meet EISA requirements for monitoring to verify savings. The 2009 draft UESC policy stresses the need for an M&V plan.

Additionally, ACSIM needs to ensure that the new UESC policy will include appropriate O&M planning that ensures effective O&M. We identified three main options for this. First, an installation can provide independent external O&M oversight. Having an independent third party reviewing O&M procedures can help ensure that proper operations and maintenance are being performed.

The second option is to involve installation O&M staff in the UESC project technology selection and implementation process and ensure that they have proper training. If O&M staff members are comfortable with the technology being used in UESC projects, they are more likely to have the capability to provide better maintenance to the systems installed. Besides involving O&M staff in the selection and implementation process, installation O&M staff must have the proper training and motivation to perform appropriate O&M. Fort Campbell provides an example of how post energy staff successfully collaborated with their maintenance staff and ensured they had the proper equipment, training, and involvement in the UESC process, resulting in effective and efficient O&M (for more details, see the Fort Campbell case study in Appendix A).

The third option to ensuring effective O&M is to have a qualified O&M contractor as part of the UESC contract. This contractor should have demonstrated expertise for the equipment types being used. Fort Knox provides an example of how this approach was successful in achieving effective UESC project O&M. In fact, Fort Knox built the cost of contracting the O&M into its actual UESC projects (for more details, see the Fort Knox case study in Appendix C).

Regardless of which approach is used to ensure effective O&M, the new UESC policy should require that installations develop a maintenance plan that is effectively implemented. The 2009 draft Army UESC policy guidance includes such a maintenance plan requirement. ACSIM, IMCOM, and other relevant Army commands should ensure that installations effectively develop and implement such maintenance plans for future UESC developments.

The new UESC policy should also recommend that installations include building commissioning as part of their UESC process, as Fort Campbell does. Where possible, a third-party independent commissioning agent should be employed for the building commissioning. However, this usually costs more than having an internal party or contract team member perform the commissioning.

The UESC policy should also briefly explain monitoring-based commissioning, since some installations may want to take advantage of this newer process. As Army facilities become more serious about reducing energy consumption, maintaining past improvements, and verifying energy performance, they should look to the example of commercial buildings that are beginning to adopt monitoring-based commissioning.

Monitoring-based commissioning begins with a traditional commissioning process, but also requires having an energy information or building diagnostic system and then using the information from that system to continuously measure performance and make ongoing adjustments to maintain and improve performance over time. It has been found that monitoring-based commissioning can sustain and improve performance continuously.¹⁴

UESC Handbook Should Provide Examples of Successful Practices

As an additional resource, the above-recommended UESC handbook developed by ACSIM should provide detailed examples of successful M&V, O&M, and building commissioning practices so that these can be implemented at other installations. Again, these should include a detailed “how-to” for the practices so that they can be more easily implemented. Several installations stated that they are struggling with such issues and that it would be helpful to have detailed case study descriptions about how other installations have successfully addressed issues such as the M&V and O&M issues. Such examples should include lessons learned and how the posts effectively overcame common barriers to developing and implementing UESCs, such as how to work with contracting and legal staff, and how to implement M&V, O&M, and building commissioning. Providing a range of different successful approaches would also be useful. A UESC handbook could expand on the case study examples presented in the appendixes of this document, such as the different successful O&M approaches implemented at Fort Campbell and Fort Knox.

Broader Collaboration Issues That Are Not UESC-Specific

We recommend five key activities to address these broader non-UESC-specific collaboration issues in the following categories: (1) provide information and training on non-UESC collaboration mechanisms to installation staff, (2) increase information exchange and collaboration with utilities and utility associations, (3) take more advantage of utility interest in key areas, (4) provide more information and training on such opportunities in these key areas, and (5) ensure that installations can use incentives for energy program investments.

Provide Information and Training on Non-UESC Collaboration Mechanisms to Installation Staff

ASCIM, IMCOM, and other commands should provide information and training (through conferences, classes, and documented case studies) to installation staff on

¹⁴ For more details on monitoring-based commissioning, see Evan Mills and Paul Matthews, *Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects*, LBNL-1972E, Lawrence Berkeley National Laboratory, June 2009.

non-UESC collaboration mechanisms such as EULs, PPAs, and USCs. For example, presentations at the GovEnergy conference are an effective method to get some of this information across to installation staff. Detailed installation case studies could provide a step-by-step “how-to” for installation staff to implement these non-UESC collaboration mechanisms. Such case studies should include lessons learned, barriers that were encountered and how to overcome them, and sample contracts and contracting language. Expanding on the Fort Carson appendix in this report would be an example of such a case study. Since so few Army examples exist in some of these areas, other Service installations’ experiences should also be written up as case studies such as the Tinker and Nellis AFB examples discussed earlier. Since FEMP has an interest and knowledge in these mechanisms, such as PPAs, it might be able to help write up such case studies as well as provide presentations at GovEnergy. In general, information and training that is provided to installation staff by ACSIM and IMCOM needs to have more emphasis on these non-UESC collaboration mechanisms. They should also encourage installations that have successfully used such mechanisms to network with energy managers at other installations about them.

Increase Information Exchange and Collaboration with Utilities and Utility Associations

Additionally, ACSIM, IMCOM, and other commands should increase information exchange and collaboration with utilities and utility associations. ACSIM should schedule regular meetings with utility associations and major utilities to discuss key areas of interest, including on-site collaboration, financial mechanisms, energy security, metering and smart grid systems, and demand response. ACSIM already started such a process with EEI representatives in June 2008 to discuss areas of mutual interest. Such meetings should continue on a regular basis, e.g., every other month or three or four times a year. ACSIM and IMCOM should also work with such groups to set up special information-sharing sessions or workshops on key topics such as energy security. ACSIM and IMCOM should also ensure that they participate in relevant meetings and working groups in which utilities are taking a leading role. A group of utilities and other stakeholders have developed a working group to look at standards for smart grids. The Army should participate to ensure that its needs are incorporated into the standards. Similarly, DOE runs a working group on developing smart grids with utilities, and the Army should participate in it. How such concepts evolve in the future will affect the Army, so it should proactively participate and collaborate with utilities now as these systems are being designed and developed for the future.

Take More Advantage of Utility Interest in Key Areas

Utilities already have interests in certain key areas that installations should be taking more advantage of. As discussed earlier, these areas include on-site power generation, energy security, metering and smart grid, demand response, and other incentive pro-

grams. ACSIM, IMCOM, other commands, and installations should be pursuing more collaboration in such areas. Since many utilities have strong interests in collaborating in such areas because of the benefits discussed in Chapter Three, there are opportunities that should be pursued now. Army headquarters organizations and installations need to “think outside the box” to identify when these other types of collaborative opportunities should be pursued. Many utilities can help with ideas. For example, the Army’s metering budget was cut to zero in 2008. One utility representative noted that utilities might have been able to help: because a utility can spread the cost of new meters over a longer time horizon, Army decisionmakers might have been more willing to pay for their installation through a small increase in monthly utility bills over several years rather than by absorbing a large, one-time O&M outlay.

ACSIM and IMCOM should help encourage and fund installation pilots in such areas. They have already done some of this by supporting the Fort Carson and Fort Irwin on-site solar power generation projects and pursuing net zero installations. More of these activities should be pursued. Similarly, more installations should be willing to pursue such pilot activities. For example, more installations should try to participate in demand response programs.

Provide More Information and Training on Such Opportunities in Key Areas

Another recommendation is for ACSIM, IMCOM, and other commands to provide more information and training on such opportunities regarding on-site collaboration, energy security, metering and smart grid, demand response, and other incentive programs to installation staff. The Army should encourage and provide special sessions on these topics at key conferences, such as GovEnergy and FUPWG. The Fall 2008 FUPWG conference provides a good example of such activity because it had a session that focused on demand response and sessions focused on energy security. ACSIM and IMCOM should also consider providing special workshops and conferences on these topics, like they did with the Energy Summit in Richland, Washington in July 2008 with the theme “Moving Forward with Renewable Energy.” The Army could have a national or regional meeting focused on smart grid and smart metering concepts to help installations learn about how these concepts are evolving and how they are relevant to the Army. A utility or a utility association, like EEI, could help provide speakers and information—or co-sponsor it—as they sometimes do with UESC workshops. DoD, other Services, and DOE could also be potential partners in helping with such workshops. FEMP could help provide training to installations about participating in demand response programs. Once installation staff are more informed about and equipped to address these areas, they should be able to more easily pursue collaboration opportunities with utilities.

Ensure That Installations Can Use Incentives for Energy Program Investments

Lastly, ACSIM should try to ensure that installations can use incentives for energy program investments. As was discussed in the last chapter, a main reason installations do not participate in demand response and other utility incentive programs is because the installation energy program has difficulties in directly taking the rebate checks. Often the money goes back to the federal government general fund rather than to the installation energy program. Some installations have found ways to address this issue, such as getting discounts on utility bills, but the Army should streamline some of the red tape and logistics required to make this happen so that installations can more easily take advantage of incentives. Namely, installations want assured savings retention. ACSIM energy staff have been participating in an Army working group that is addressing this issue.

Highest-Priority Recommendations

In our interviews and analysis, we identified several recommendations that have common themes in addressing barriers to installations and utility collaboration. Implementing these recommendations could help address multiple barriers. Namely, we identified five high-priority recommendations that are both feasible to implement and will have the most influence on improving Army installation collaboration with utilities. These recommendations are:

1. Establish a full-time energy manager at each installation, ideally at the GS-13 level for larger installations.
2. Provide an Army UESC policy and handbook throughout the Army.
3. Expand installation staff UESC education and training.
4. Provide more technical assistance to installations and utilities.
5. Allow a longer payback period for UESCs, as long as 30 years or more.

Establish a Full-Time Energy Manager at Each Installation, Ideally at the GS-13 Level for Larger Installations

Installations need a qualified full-time energy manager on staff in order to handle the workload required to meet energy goals. In fact, Army policy is to have a qualified energy manager at every installation. The importance of this goal has been stressed in “The Installation Management Campaign Plan 2010–2017,” which has the following subtask:

Provide full-time, trained professionals (Certified Energy Managers (CEM)) to lead the energy program on each installation and within all IMCOM Regions, Army Reserve and National Guard locations and other land owning commands.¹⁵

This is arguably the most important thing the Army could do. If the Army implemented this one suggestion it would help improve installation successes in collaborating with utilities via UESCs and other ways, and it would help overall installation energy programs. Because many installations are understaffed, numerous potential energy efficiency projects are not able to be pursued. A full-time energy manager is necessary to take advantage of more of these opportunities.

Additionally, the energy manager position would ideally be allowed to be at the GS-13 level position at larger installations. Having the position currently limited to a GS-12 at even the large installations causes significant turnover in the position, which is detrimental to pursuing energy efficiency projects and meeting energy goals. Each time an energy manager leaves, there is often a period of vacancy in the position, and once it is filled, there is a sometimes a significant learning curve to get the new energy manager up to speed on the installation's energy program. Having the energy manager position be a GS-13 level position, or to at least have promotion potential to GS-13, would encourage staff to stay in the position longer, thus having more continuity for the installation's energy program. An energy manager at this level would also be more likely to have the training, experience, and skills to pursue UESCs and other utility/installation collaboration projects.

Provide an Army UESC Policy and Handbook Throughout the Army

ACSIM should provide installations with a policy and a handbook detailing how UESCs should be implemented. This would not only increase the visibility of UESCs but also promote the education of energy, DPW, contracting, legal, financial, and other installation staff so that they are better prepared to take advantage of UESC opportunities. ACSIM already has developed a draft UESC policy, which is a good first step. It needs to be finalized, issued, and widely distributed throughout the Army. Next, an in-depth handbook should be developed to help explain utility and UESC collaboration to installation staff. This handbook should include items such as detailed examples of successful Army installation M&V and O&M practices and should be distributed to diverse installation staff, including energy, contracting, and legal staff. This handbook could go beyond UESCs to also include broader installation energy issues to assist in getting new energy managers up to speed. It would then also include information about financial mechanisms, demand response, energy security, renewable energy, metering, smart grid systems, and on-site power generation collaboration opportunities.

¹⁵ IMCOM, "The Installation Management Campaign Plan 2010–2017," Version 3.0, April 2011, p. 41.

Expand Installation Staff UESC and Utility Collaboration Education and Training

Installation staff UESC and utility collaboration education and training should be expanded so that staff members are more equipped to take advantage of collaboration opportunities. ACSIM and IMCOM should take the lead on such education and training. One way to do this is to simply provide more installation staff training on relevant collaboration issues such as the legal and contract background on implementing UESCs or new renewable energy technologies. Additionally, installations should have diverse staff, including legal, contracting, financial, and energy staff, attend relevant workshops such as the UESC and GovEnergy conferences. The conferences not only provide education on UESCs and related issues, but also provide opportunities for installation staff to network and benefit from attendees' different areas of expertise. Another way education should be expanded is for installation energy efficiency project success stories to be documented as detailed "how-to" case studies. If one installation has had success with a particular funding vehicle or energy technology, for example, this should be documented so that it can be implemented at other installations. Lastly, ACSIM and IMCOM should encourage installation staff to network and share information across installations, such as providing conference calls and Internet mechanisms for sharing information on key topics like PPAs, UESCs, on-site generation, demand response, and energy security.

Provide More Technical Assistance to Installations and Utilities

Another way to promote collaboration is to provide more technical assistance to installations and utilities. Again, as discussed earlier, ACSIM and IMCOM should take the lead in encouraging and providing such assistance. Entities such as PNNL and FEMP can provide technical expertise to installations and utilities to facilitate collaboration. PNNL can provide services such as recruiting utilities that have not participated in UESCs in the past, providing sample contract vehicles to the utility company to help eliminate contracting hurdles, and evaluating the technical viability of a project. This assistance can pertain to UESCs or can also include other collaboration options such as demand response, renewable energies, and USCs.

Allow a Longer Payback in UESCs

Finally, the UESC contract length and thereby the payback term should be increased to at least 30 years. Such an extension would help make UESCs more attractive to utility companies. The current 10-year contract length and thereby payback term is very limiting and may discourage the use of UESCs. It is particularly problematic for renewable energy projects, as these take longer to show savings. As renewable energy technologies become more and more relevant, increasing the UESC payback term becomes all the more crucial in order for installations to be able to take advantage of opportunities to meet energy goals.

Conclusions

Clearly, Army installations have demonstrated many benefits from collaborating with utilities. These benefits include saving money and reducing energy consumption, increasing energy reliability and security, and establishing a long-term working relationship for the mutual benefit of the utility and installation. However, more Army installation and utility collaboration would help to meet federal and Army energy goals. Further collaboration could work toward meeting goals in areas such as energy conservation, renewable energy investments, energy security, and cost-effectiveness. To take advantage of these opportunities, the Army should place more emphasis on UESCs and other utility collaboration options. We have identified the key barriers to Army installation and utility collaboration and have provided recommendations to overcome them. Most important, the Army needs to provide installations with full-time energy managers, ideally for larger installations at a higher pay grade authorization, namely a GS-13 level; allow a longer UESC payback period, as long as 30 years or more, to increase flexibility; and provide education, training, and technical assistance on collaboration mechanisms. By implementing these and the other recommendations in this study, Army installations can collaborate more with utilities and create increased efficiency and benefits to the Army, utilities, and the nation.

Fort Campbell Case Study

This appendix provides a summary of some of the ways that Fort Campbell has been collaborating with utilities, most notably its successful UESC implementation. It is designed to be a detailed installation story that illustrates many of the issues raised in the main text as they have played out at Fort Campbell. To set the context, it begins with an overview of Fort Campbell and its sustainability program. Then it briefly describes the post's energy organization and how it interacts with its utilities. Next it describes Fort Campbell's UESC process and some of its UESC projects. It ends by briefly discussing some other energy projects at Fort Campbell.

Overview of Fort Campbell

Fort Campbell is located between Clarksville, Tennessee and Hopkinsville, Kentucky and supports the third-largest military population in the Army. It consists of 164 square miles (over 105,000 acres), with about 37,000 acres in Kentucky and 68,000 in Tennessee. Approximately 50 percent of the land surrounding Fort Campbell is farm and woodlands. Fort Campbell is home to the 101st Airborne Division (Air Assault) and other units, and its major command is the 18th Airborne Corps and FORSCOM. The installation supports a military population of about 25,000 soldiers, over 46,000 dependents, and over 4,300 civil employees.¹ Fort Campbell has about 63,000 acres of training areas including maneuver lands, landing zones, and drop zones, and 26,000 acres of impact areas (firing ranges and demo areas). The cantonment area consists of 14,000 acres and includes unit administrative, soldier barracks, family housing, a town center, and major airfields. At the time when its Long-Range Energy Management Plan was formulated in 2005, Fort Campbell had over 1,240 buildings and over

¹ Department of the Army, "Fiscal Year 2004 Secretary of Defense Environmental Awards Nomination: Pollution Prevention (Installation) Fort Campbell, Kentucky," 2005, p. 1.

12 million square feet;² it has since expanded to more than 1,470 buildings and over 16 million square feet.³

Fort Campbell has an active building retrofitting, construction, and upgrading program. The installation is expanding, with an increase in soldier strength of 7,000 people.⁴ Because of the 2005 BRAC round, the 52nd Explosive Ordnance Disposal (EOD) Group is being relocated to Fort Campbell, and an attack aviation battalion that has been at Fort Campbell is being relocated to Fort Riley, Kansas. In addition, from the Army Modular Force and the Integrated Global Presence and Basing Strategy reorganizations, the 2nd Brigade Combat Team (BCT) and 159th Combat Aviation Brigade (CAB) have been relocated to Fort Campbell. All this activity means that the installation has a lot of planned construction. The 2nd BCT Complex and the 159th CAB Complex are being designed and expected to each contain barracks, dining facilities, motor pools, headquarters and operations facilities, and supporting infrastructure and utilities. Even before the BRAC expansion, because of new barracks and other related construction, approximately 2,500,000 square feet of new buildings were planned at Fort Campbell through FY10.⁵

Because of the synergies between the post's sustainability and energy programs, we next briefly overview the energy elements in the Fort Campbell's sustainability program.⁶

Fort Campbell Sustainability Program

Fort Campbell has an active sustainability program with energy-related targets in it. The Installation Sustainability Plan has been integrated into the Installation Strategic Plan. Strategic Goal 2 of this plan is "Sustain, Transform, and Modernize the Installation." Under this goal are two main objectives: "Implement Installation Sustainability" and "Transform and Modernize Installation Infrastructure." Both of these areas include energy components, and Fort Campbell's Department of Public Works (DPW) has the lead on them.

The "Implement Installation Sustainability" objective's definition is:

² Fort Campbell, "Long-Range Energy Management Plan Fort Campbell, Kentucky," March 2005, p. 20.

³ Personal communication via email, Neal Dewayne Smith, Energy Manager/DPW at Fort Campbell, November 29, 2010.

⁴ Jim Duttweiler, "Fort Campbell Sustainability Program Update," briefing, DPW, Fort Campbell, Kentucky, June 20, 2007, p. 15.

⁵ D. R. Brown et al., "Fort Campbell Kentucky Final FEDS Assessment and 10-Year Energy Plan," Pacific Northwest National Laboratory, April 2, 2004, p. 5.

⁶ For more details on the relationships between sustainability and energy programs, see the Fort Carson and Fort Lewis appendixes. Both these installations have had sustainability programs longer, so these appendixes provide more details on the history and relationships between the two programs.

Implement a proactive approach to plan for long-term mission viability and integrity while at the same time minimize the consumption of resources and reduce the impact on the surrounding communities and environment. A key feature is to assess the current and future needs of our installation for training land, and assess reliable, secure, and low-cost energy and water. Sustainment strategies must be implemented to minimize or reduce the total use of resources, ensure mission readiness, and improve the quality of life for Soldiers while protecting the local communities and environment.

The “Transform and Modernize Installation Infrastructure” objective’s definition is:

Reshape and improve predictable installation systems, installation information infrastructure, power projection infrastructure, and environmental programs to improve the quality of the installation and support quality training and operations while transforming. Ensure the availability of efficient, effective installation operations, services, and facilities.

One initiative under this objective is “Utilize energy efficient systems in facilities to reduce energy consumption.”⁷

The accomplishment of this installation strategic plan will not be without challenges. The dynamics of the Fort Campbell mission require infrastructure, utilities, and an increasing demand for energy.⁸

Overview of Fort Campbell’s Energy Program

Fort Campbell has had an active and successful energy management program since the 1980s. The level of success of the program has varied over the years, often based on staffing issues. As with many installations, when there are shortages in energy management staff, the energy program is not as active. An example of a historical success was in 1997, when Fort Campbell was nominated for a Federal Energy Saving Showcase Facilities award because it replaced single-stage steam driven absorption chillers with more efficient natural gas engine driven chillers (250–570 tons) in three barracks buildings. Additional absorption chiller units were replaced with gas cooling units in FY97.⁹

Executive Order 13123 requires that energy use intensity (millions of Btu per thousands of square feet per year) at all military installations be reduced by 30 percent

⁷ Fort Campbell, *Installation Strategic Plan: Sustainability Program Annex, Implementation Plan, 2007–2012*, Fort Campbell, Kentucky, 2007.

⁸ Fort Campbell, “Long-Range Energy Management Plan Fort Campbell, Kentucky,” March 2005.

⁹ Army Energy Program, “Energy Success Stories—Fort Campbell Natural Gas Engine Driven Chillers,” updated January 4, 2010.

in 2005 and 35 percent in 2010 as compared to a 1985 baseline. Through FY04, Fort Campbell was 14.67 MBtu/KSF above the 2005 goal and 23.2 MBtu/KSF above the 2010 goal. An average reduction of 3.5 percent was needed to meet the 2010 target. Figure A.1 shows Fort Campbell's energy savings and its planned compliance glide path to meet these goals.

Fort Campbell has taken an aggressive approach aimed at not only ensuring energy consumption within these targets, but also providing significant dollar savings and improved quality of life.¹⁰

More recent program success is illustrated by a 2008 award. In 2008, the Department of the Army named Fort Campbell as a top achiever in energy and water conservation with a 30th Annual Secretary of the Army Energy and Water Management Award in the Energy Efficiency/Energy Management category. The award was for energy savings of \$2.2 million/247,646 MBtu from three UESC projects with Tennessee Valley Authority (TVA) and Pennyryle Rural Electric Cooperative Corporation (RECC). The projects were a boiler decentralization, implementing ground source heat pumps (GSHPs) for HVAC, and boiler/chiller system improvements.

Fort Campbell's energy program focuses on three primary elements: awareness, projects, and maintenance. Awareness occurs through the energy conservation officers and building energy monitors, who help promote energy conservation in post buildings. Projects are accomplished through the UESC program, ECIP program, and ESPC program. There is an old ESPC for lighting and have been some ECIP projects in the past. However, most of the current projects are being implemented through UESC projects. Since 2005, UESCs have been the most important source for the funding of energy conservation activities.

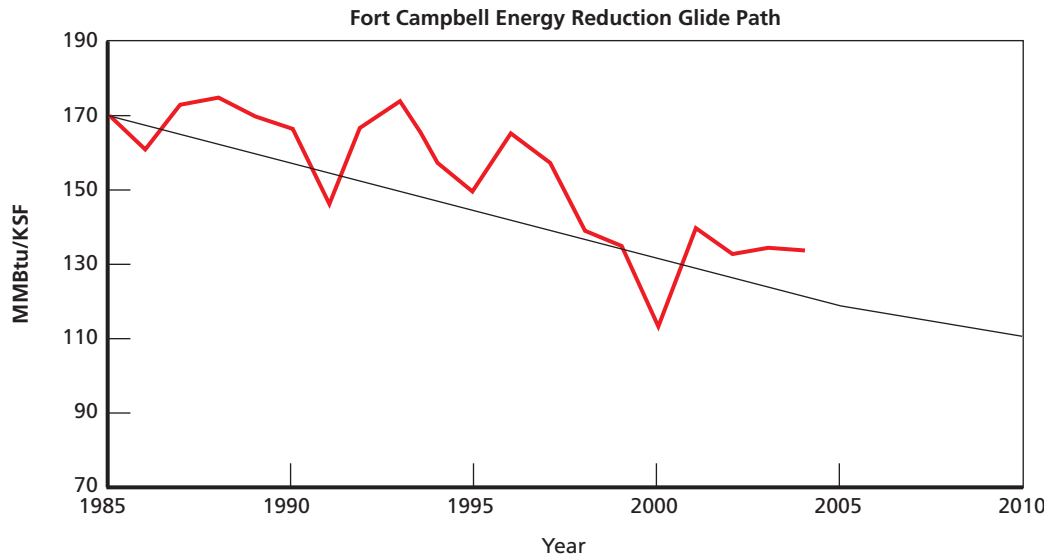
Energy Staff and Staffing Issues

The energy management function falls under the Department of Public Works (DPW) at Fort Campbell. The DPW provides for maintenance of the installation infrastructure and environment. The DPW consists of six divisions: the Engineering Division, the Operations and Maintenance Division, the Environmental Division, the Housing Division, the Master Planning Division, and the Business Management Division. The Engineering Division is responsible for the planning and estimating of all infrastructure improvement and maintenance programs. The Operations and Maintenance Division is responsible for the actual maintenance and improvement of the installation property, buildings, and facilities.

The DPW, through the utility management branch chief, is responsible for monitoring the consumption of utilities, executing the energy conservation education program, developing and managing the UESC and ESPC plans, developing and coordinating the ECIP projects, and reporting. The branch chief accomplishes this through

¹⁰ Fort Campbell, "Long-Range Energy Management Plan Fort Campbell, Kentucky," March 2005, p. 9.

Figure A.1
Fort Campbell Energy Use, 1985–2005



an energy manager and other utilities staff. The energy manager works for the utility management branch chief.

The current energy manager has been in that position since early in 2004. He was hired because the previous energy manager had left. He is a contractor with a five-year contract with an annual renewal. He had previously worked for 30 years at the installation and for the USACE in a diverse range of energy, environmental, and building operational and oversight functions. Because of this history and experience, he has a good understanding of how the installation functions and of different organizations on the installation, which has helped in his energy management function.

DPW staff turnover has been an issue at Fort Campbell. For example, there have been four different utility management branch chiefs within a recent year.

Fort Campbell has had an important advantage by now having the energy manager contract in place, which provides stability. The company that the energy manager works for can provide an immediate replacement for him if he leaves.

Fort Campbell's Relationship with Its Utilities

Fort Campbell has a good working relationship with its utilities. At Fort Campbell, water, sewer, and gas are privatized, and electricity is not. The City of Clarksville Gas and Water Department provides natural gas to the installation. Natural gas, water, and wastewater were privatized in 2003. Pennyrile RECC, Cumberland Electric Membership Corporation, and Clarksville Department of Electricity provide electricity to

the installation, and the TVA is the distributor of the electricity. TVA and Pennyrile RECC are the two utility companies that the installation works with the most.

Fort Campbell works with TVA and Pennyrile RECC to validate utility bills, to develop and implement UESC projects, and to explore mutual interests in renewable energy. For example, TVA has a request for proposals (RFP) out for those who may consider providing renewable energy to TVA, and Fort Campbell is exploring whether or not there is any feasibility in their participating. Fort Campbell energy staff also take advantage of TVA technical expertise and classes. The energy manager took a TVA course in 2007 on mold and mildew problems, which focused on energy system effects on mold.

The UESC Process

In this section we provide an overview of how the UESC process works at Fort Campbell. We begin with a short history of how the installation started doing UESCs and developed its basic ordering agreement (BOA). Then we provide an overview of some of the UESC projects. First, however, we briefly summarize some of the main features of the UESC process. Key components of Fort Campbell's UESC process include a UESC Board, UESC Quality Assurance Evaluator, building commissioning, M&V, and effective maintenance. Each of these issues is discussed more after the history discussion. Figure A.2 provides a diagram of Fort Campbell's UESC process from developing the BOA through project implementation.

The UESC mission at Fort Campbell is to meet the needs of the customer (occupant), namely, "leave the building better than we found it," ensure long-term maintenance, and provide energy savings and cost avoidance.¹¹ The installation has had a successful UESC program. Since fiscal year 2005, Fort Campbell has awarded six UESCs for a total annual savings of \$4,232,884 by December 2008.¹² Other UESC results have included a completion of energy audits for all buildings on post, the implementation of many Energy Conservation Measures (ECMs), building improvements, and reduced maintenance. Examples are provided in the discussion below.

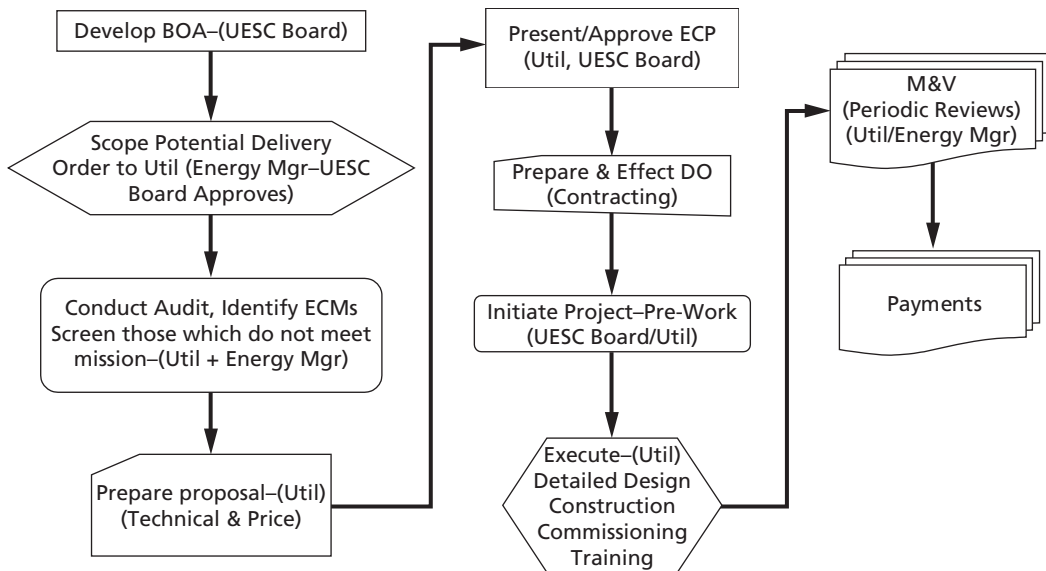
History of UESCs at Fort Campbell

In early 2004, the energy program at Fort Campbell was having some difficulties with its ECIP projects. The ESPC program was in moratorium in 2004. Fort Campbell had three or four ECIP projects, but they were old and were not working as planned. These

¹¹ Dewayne Smith, "Lessons Learned: Utility Energy Services Contracts," briefing, IMCOM/Southeast Region Energy Managers Forum, Atlanta, Georgia, February 13, 2008.

¹² Jerrie Macintire, "Campbell Departments Sweep Competition," *The Fort Campbell Courier*, Vol. 44, Number 50, December 2008.

Figure A.2
Diagram of Fort Campbell's UESC Process



SOURCE: Dewayne Smith, "Lessons Learned: Utility Energy Services Contracts," briefing, IMCOM/ Southeast Region Energy Managers Forum, Atlanta, Georgia, February 13, 2008.

RAND MG1126-A.2

projects focused on EMCS-type work. Part of the problem was that there were three separate contracts and three separate contractors for the work. The contractors had proprietary concerns, and the local DPW staff were given EMCSs without graphics and without proper training. Also, because of the proprietary issues, other buildings could not be brought onto the system. These projects were dragging out and were not working very well.

In 2004, Pacific Northwest National Laboratory (PNNL) completed a statistical site-wide energy assessment of Fort Campbell's facilities to identify opportunities for energy savings. With PNNL's help, an energy planning workshop was held at Fort Campbell on June 6–8, 2004. Its aims were to review the site-wide energy assessment results, bundle energy efficiency measures into logical projects, consider appropriate choices for project funding/financing, and establish a time-phased plan for project implementation.

The energy manager invited the public utilities (TVA and Pennyrile RECC) to attend the workshop. Representatives from these utilities and installation legal and contracting staff also attended. The energy manager had also spoken with the energy manager at Fort Knox about his UESC program and had a representative from Fort Knox attend to make a UESC presentation.

The Fort Campbell energy manager saw the advantages of UESCs, and they became a quick, natural fit at Fort Campbell. PNNL's workshop was the catalyst to help get the program started. Fort Campbell energy staff liked dealing with the local utilities because they had a genuine interest in the work and were not going away.

Fort Campbell already had a BOA in place with TVA, but it had not been used and had expired by 2004. The energy manager met with the Fort Campbell contracting and legal personnel to see if the BOA could be reactivated, and they were able to add an extension to the BOA with TVA. Shortly after that, a BOA was set up with Pennyryle RECC. Using these two contracting vehicles, Fort Campbell was able to do two initial UESCs, one with TVA and then one with Pennyryle RECC. Pennyryle RECC is a distributor for TVA. Since the two utilities were not competing with each other, they were able to create a partnership and work together. There was plenty of work for both utilities, so they were both happy. The energy manager made sure there was open communication with the utilities so that both were comfortable.

With TVA, Fort Campbell could immediately activate the delivery order and had the utility doing work at Fort Campbell within less than a year. During that time, Fort Campbell developed the separate BOA with Pennyryle RECC and in a little over a year started UESC work with that company. Since 2004, Fort Campbell has had concurrent activities with both utilities. The utility companies have separate capabilities and expertise. TVA has more experience in the larger boiler plant business and in GSHPs. TVA had its own energy service company (ESCO) already on board. Pennyryle RECC had to choose an ESCO and went with Johnson Controls.

UESC Board Provides Coordination and Oversight

An important part of the UESC process at Fort Campbell is the UESC board. When a UESC project is starting to take shape, the energy manager calls a meeting of the UESC board, which involves all relevant parties and includes representatives from the following sectors of the Department of Public Works: the energy manager, operation and maintenance, utility management, engineering, and budgeting staff. Additionally, the contracting officer and the Staff Judge Advocate (SJA) are included in the board. When a specific building is involved in a project, then a representative from that building is included. At the board meetings, the energy manager explains the plan for the new project and sees whether everyone is in agreement to move forward or if there are any issues or concerns that need to be considered in the project. The next step is to have the ESCO put a proposal together and evaluate its feasibility. The energy manager then brings the proposal to the board for approval. Because of payback criteria, sometimes they have to alter the plan and blend different ECM ideas to make the project work. Historically, the board asked the contracting person how long it would take to get a delivery order awarded and had them take it from there.

UESC Quality Assurance (QA) Evaluator

Because of concerns about the long-term payback and the risk to the federal government inherent in UESCs, as well as ESPCs, Fort Campbell has a strong QA process. To reduce the risk and ensure the highest probability that the UESC projects will pay for themselves, Fort Campbell spends more on quality control. Fort Campbell has a quality assurance evaluator (QAE) on every project to ensure quality and thereby help reduce the project risk. The role is currently held by an experienced retiree, with in-depth knowledge of the organization. The QAE is responsible for quality assurance and the coordination of several elements: building owners, information management staff, commissioning personnel, and maintenance personnel, including work order requests and maintenance plans. Since 98 percent of the work is done in existing buildings, additional problems will often be found during the work. Thus, another role of the QAE's is to identify maintenance problems and get maintenance staff to fix them before the work is started. If the QAE sees a dirty filter or a loose belt that is not in the scope of the UESC, then he submits a work order request for it to be fixed prior to the UESC work starting. The cost of the QAE is folded into the UESC upfront.

Building Commissioning

At Fort Campbell, "commissioning is an integral part of the plan for implementation of all UESC projects."¹³ Fort Campbell has employed two different methods for building commissioning: third-party independent commissioning and internal contractor commissioning. The third-party commissioning agent is often the preferred method, since he/she is independent; however, it is more expensive. With TVA, Fort Campbell uses a third party. For the first TVA project, Smith, Seckman and Reid was engaged to provide commissioning services. For the Pennyrile RECC contract, Johnson Controls, the contractor, provides the commissioning. Installation staff would have preferred a third-party commission agent, but it was an issue of cost. The internal commissioning seems sufficient so far.

Maintenance Issues

An important component of the Fort Campbell UESC process is ensuring that a maintenance plan is in place for every project. Fort Campbell will not do a UESC project without a maintenance plan. The energy manager is sensitive to the maintenance staff concerns and has a good working relationship with them from his years of experience at Fort Campbell.

Maintenance staff concerns at Fort Campbell can best be understood by explaining the problems that they have experienced with MILCON projects. Every MILCON project is new and usually involves getting new equipment and suppliers without any training for the maintenance staff. This can be a major frustration for the maintenance

¹³ Fort Campbell, "Long-Range Energy Management Plan Fort Campbell, Kentucky," March 2005, p. 24.

staff, who feel like victims in these cases: forced to maintain equipment after it is built, equipment they had no vote in selecting and for which they received no training, since there is always a shortage of funding for training. The energy manager's solution to address such concerns is to get the maintenance staff's input and to install equipment that the maintenance staff is already familiar with whenever possible.

Often, UESC projects at other installations do not include a specific maintenance plan. At Fort Campbell, however, they consider how the work will be maintained in order to ensure the savings over time. As part of this planning process, the energy manager meets with the maintenance personnel and asks them what they want and what they are comfortable with. Then the maintenance staff's desires are incorporated into the UESC project. If the energy manager knows that the maintenance personnel are comfortable working with and want a Trane chiller, he states that the UESC project should include a Trane chiller if possible. This is also the case with boilers—he requests that the model and type that his maintenance staff knows how to operate and maintain be installed. Because of this collaborative approach, the maintenance personnel are big supporters of UESC projects because they know that their concerns and interests are being heard and addressed in the projects. In addition, whenever new equipment (like GSHPs) needs to be put in place, the UESC maintenance plan ensures that the maintenance staff have proper training for it.

M&V Issues

Fort Campbell includes M&V in its UESC projects. Detailed ongoing project M&V is very expensive. The amount and level of M&V included is based on the project's characteristics. When installation staff know the system well and the expected savings are well known from engineering calculations—such as with light bulb replacements—then there is no M&V. The energy manager did not include M&V on the first UESC project he did at Fort Campbell. The first project was a boiler plant replacement, and since this had obvious savings, there was no M&V.

However, M&V was included on the first GSHP project, since it was a new system at Fort Campbell. TVA monitored four barracks for a full year to validate GSHP performance. One of the barracks had GSHPs, the other three did not. The payback was validated.

Since then, Fort Campbell UESC projects have required M&V on all projects for the full 10 years. M&V is of mixed type, where some boilers are monitored regularly, EMCS involves scheduling data, and lighting involves engineering calculations, not actual monitoring. For boilers, the M&V has included periodic updates during the year to see if there are problems and to ensure that any needed changes can be made without losing savings. The energy manager is looking at an M&V blended approach in order to save money, which means the systems would not be monitored every year.

UESC Projects

We briefly describe a few of the Fort Campbell UESC projects in this section.

First TVA Project

The first TVA project involved an old central energy plant. As part of the UESC process, the TVA assessment found the plant to be inefficient, with numerous steam leaks on the distribution system and other problems. The solution was to provide efficient modular boilers and improved controls to the 20 buildings served by the plant. The plant was shut down and decentralized, with individual boilers and water heaters put into barracks-type buildings. There was major immediate improvement: the old system ran at 35 percent efficiency, whereas the new system was up to 80 percent efficiency. This project also included lighting upgrades, HVAC system improvements, insulation, and reactive power compensation. This initiative has an annual energy savings of \$904,444 or 129,886 MBtu.¹⁴

Ground Source Heat Pumps (GSHPs)

Fort Campbell's second project provided the conversion of HVAC in one of the four similar barracks buildings to a GSHP system. This was the first commercial GSHP system in Fort Campbell and supports the installation's renewable energy objectives.

This pilot project for GSHP energy was part of a larger project. As discussed under M&V, TVA monitored all four barracks for a full year to validate performance. One of the barracks had GSHPs, the other three did not. The GSHP barracks, which has 89 individual room heat pumps in the system, produces an annual energy savings of \$177,149 or 21,396 MBtu.¹⁵

GSHPs were new to the maintenance staff. Because the technology had only been at Fort Campbell for about two years, there had been no maintenance issues to deal with at the time of this study. In general, there is low maintenance required with such GSHP projects. It is a relatively unsophisticated renewable technology. But if there is a crisis and a well fails, the installation will have to call in a well expert.¹⁶

Fort Knox using GSHPs successfully helped motivate Fort Campbell to try them. A significant benefit of GSHPs is fixing the seasonal changeover problem, which inconvenienced building occupants. With the old central system, the barracks would have two to three weeks without heat or air conditioning during the changeover. With

¹⁴ U.S. Army, "30th Annual Secretary of the Army Energy and Water Management Award: In Recognition of Accomplishments during Fiscal Year 2007," Award Summary, 2008.

¹⁵ U.S. Army, "30th Annual Secretary of the Army Energy and Water Management Award: In Recognition of Accomplishments during Fiscal Year 2007," Award Summary, 2008.

¹⁶ The GSHP project had subsequent maintenance issues after the completion of this study and during the review process.

GSHPs, the customer can have heat or air conditioning whenever desired, so there is no longer a seasonal changeover problem. Customer satisfaction is much higher.

Barracks Improvement Project

Because of his previous installation experience, the energy manager understood the engineering and master planning functions at Fort Campbell and was aware of other work that was going on at the installation. The Barracks Triage Program was a major funding effort by the Army in 2004 or 2005 to improve the condition of the barracks. The limited funding was aimed at aesthetics such as painting but did not include enough money for HVAC, for example. The energy manager met with the planning people doing the triage project and compared costs, suggesting that they work together to also improve the energy systems at the same time. While work was being done on the aesthetics, a UESC was employed to replace the HVAC, lighting, boilers, and hot water heaters and to install EMCS. There were some initial barriers to this activity. The contracting people were a little uncomfortable working with two different contracts at the same time, but they worked it out.

There were 11 barracks on the central power plant. The energy staff focused on the savings from decentralizing the plant. The plant already had plans in place, so this was a concurrent activity.

Under the UESC, this third delivery order provided boiler system improvements to the remaining central plant at Fort Campbell, lighting upgrades to 183 buildings, central utility monitoring and control systems monitoring and control in 88 buildings, and chilled water system improvements. With these upgrades, the controls have provided the operators an efficient and reliable system and a controlled environment for the barracks.

EMCS

By 2004, the ECIP projects had failed to put in a useful EMCS at Fort Campbell because of the issues mentioned earlier. Since then, an effective EMCS has been implemented at Fort Campbell by focusing on one system and working closely with the controls staff to have it implemented. The energy manager made sure this one system was tested and worked well for everyone before implementing it more widely.

Since the EMCS was a new system, it was important to make sure that the three controls personnel were comfortable with it. TVA had previous experience with the particular control system, a Tridium EMCS, so the energy manager proposed this system and the controls staff agreed to try it. A pilot project for the EMCS was implemented. Once it was verified to be working, the EMCS was installed in 20 buildings. As part of the UESC contract, the UESC provider was required to give major training on the system to the control staff—roughly three weeks of training focusing on the software and maintenance aspects of the system. Fort Campbell has continued to use this system, and the controls staff at Fort Campbell now comfortably use it. In spring

2009, 300 buildings at Fort Campbell were on the EMCS system, and more buildings are constantly being added.

The energy manager also worked with the Louisville U.S. Army Corps of Engineers and the Construction Engineering Research Laboratory (CERL) to use this EMCS system, since it was originally not in compliance with the guide specifications. This EMCS is now in compliance with the guide specs.

Savings from the EMCS is primarily from the building scheduling. There are individual occupancy sensors on each room in the barracks so they can monitor the rooms. For instance, if barracks occupants leave for the day for training, the unit cuts back on heating or cooling while they are gone. When no one is in the barracks room, the temperature drops to 60 degrees in the winter and raises to 80 degrees in the summer. The system returns to a more comfortable temperature when the occupant returns. The system allows for plus or minus 5 degrees adjustment by the individual occupant. Energy management staff wanted the customer to have control when they are in the barracks, but have the system control the temperature when they are away. This leads to a dramatic reduction in load. The occupancy sensor would work without EMCS, but there is a higher probability of failure. In 2007, with only 227 buildings on the EMCS, the annual energy savings was estimated to be \$1,275,085.¹⁷

Other Energy Projects at Fort Campbell

In this section we briefly describe some other energy projects at Fort Campbell that are not UESC projects. First, we briefly discuss renewable energy project ideas and then the zero-energy housing project. We discuss the role of the utility companies, if any, in these project activities.

Renewable Energy Project Ideas

Fort Campbell is using GSHPs, which is one form of renewable energy. The installation is also exploring other types of renewable energy projects. However, Fort Campbell staff are just beginning to learn about and explore other renewable energy ideas.

Energy staff at Fort Campbell have found that the ten-year payback limits the use of a UESC for renewable energy projects. However, one recent UESC proposal included domestic solar panels for domestic hot water in a UESC project that has blended savings. In spring 2009, this project was being considered in collaboration with TVA, but it had not yet been presented to the UESC board.

¹⁷ Dewayne Smith, "Lessons Learned: Utility Energy Services Contracts," briefing, IMCOM/Southeast Region Energy Managers Forum, Atlanta, Georgia, February 13, 2008.

In fall 2008, the sustainability staff and the energy manager started discussing the idea of a solar array on an old landfill. It is unclear how feasible this will be. A TVA representative attended this meeting.

In 2008, TVA also issued an RFP for those who may consider providing renewable energy to TVA. There is the potential for solar panels or other uses of real estate at Fort Campbell to create such energy. The energy manager is looking at the feasibility of doing that and potential benefits and drawbacks to the installation, but such a project, if considered desirable, would be far in the future.

Zero-Energy Housing Project

By fall 2010, Fort Campbell will become the first Army installation with zero-energy housing.¹⁸ The Residential Communities Initiative (RCI)¹⁹ contractor is doing this project, since the housing is privatized. It would not be part of the installation's EMCS, so Fort Campbell's energy staff is not involved in it. The premise of the project is for the housing to produce as much energy annually as it uses, resulting in a net zero annual energy bill. The designers are using energy modeling software to predict how the housing will perform under a number of variables.²⁰ Once the design is complete, which was estimated to be in January 2009, an on-site renewable energy source must be identified to produce the necessary electricity.²¹ The duplex houses are expected to use both solar panels and GSHPs to meet energy needs.²² The occupants of the housing will also be encouraged to practice basic conservation methods in order for the project to be successful.²³

¹⁸ Megan Smith, "Fort Campbell Plans First Zero-Energy Homes in Army," USAEC Environmental Update, Fall 2008.

¹⁹ For more information about RCI, see <http://www.rci.army.mil/>.

²⁰ Megan Smith, "Fort Campbell Plans First Zero-Energy Homes in Army," USAEC Environmental Update, Fall 2008.

²¹ Megan Smith, "Fort Campbell Plans First Zero-Energy Homes in Army," USAEC Environmental Update, Fall 2008.

²² Kristin Hall, "'Zero-Energy' Pilot Homes Planned at Fort Campbell," Associated Press, August 27, 2008.

²³ Megan Smith, "Fort Campbell Plans First Zero-Energy Homes in Army," USAEC Environmental Update, Fall 2008.

Fort Carson Case Study

This appendix summarizes some of the ways that Fort Carson has been collaborating with utilities. Fort Carson's experience is very different from the other installation case studies. It has not done a UESC. Its energy program strengths have been in the areas of sustainability program implementation, energy efficiency improvements, and renewable energy collaborations such as purchasing RECs and installing a large solar array. This appendix begins with an overview of Fort Carson, its sustainability goals, and its energy management program. It then discusses collaboration with local utility companies and concludes with descriptions of the post's renewable energy projects.

Overview of Fort Carson

Fort Carson is a 138,303-acre major Army training site located directly south of Colorado Springs in El Paso County, Colorado. It stretches south along I-25 into Pueblo and Fremont counties. The installation measures about 2–15 miles wide (east to west) and 24 miles long (north to south). The cantonment area of Fort Carson lies in the northern part of the installation, with most of the major training areas to the south and east on the post, such as three major gunnery ranges located near the southern end.

At the time of this study, Fort Carson was the home of the 4th Infantry Division; 2nd Brigade Combat Team; 2nd Infantry Division; 2nd Brigade, 91st Support Brigade; 4th Engineer Battalion; Headquarters West, First U.S. Army; the 43rd Area Support Group; and 10th Special Forces Group (Airborne).¹ Training at the installation involves tanks, other tracked and wheeled vehicles, and rotary-wing aircraft. Some joint use and training with other Services, such as the Air Force, Marine Corps, and other agencies, is also conducted at Fort Carson. Fort Carson also manages the 235,368-acre Piñon Canyon Maneuver Site (PCMS) in southeast Colorado. In 2006,

¹ This has changed since the study and will continue to do so. For example, as of mid-2010, the following major units were stationed at Fort Carson: the 4th Infantry Division Headquarters, the four Brigade Combat Teams of the 4th Infantry Division, the 43rd Sustainment Brigade, 10th Special Forces Group (Airborne), the 71st Explosive Ordnance Group, and the 10th Combat Support Hospital.

Fort Carson had over 18,000 soldiers stationed there. Fort Carson has been growing and will grow by about 15,000 soldiers since then through 2011 due to BRAC relocations. By 2009, Fort Carson had over 19,600 active-duty soldiers and over 25,300 family members. In 2008, Fort Carson had about 750 buildings with 12.865 million square feet of heated space.

Fort Carson Sustainability Program

Fort Carson has had one of the most active and long-running installation sustainability programs in the Army, which has included a large emphasis on energy conservation issues. Fort Carson's energy program has benefited from this strong sustainability program, and vice versa.

In 2002, Fort Carson started developing a sustainability program. It held a sustainability workshop in order to help develop installation sustainability goals and cross-functional teams for sustainability.

Before the sustainability workshop, Fort Carson developed a detailed sustainability baseline report covering descriptive statistics, key issues and challenges, and existing sustainability activities in nine subject areas: water, air quality, energy, transportation, lands, materials, wildlife, noise, and cultural resources. Workshop participants included representatives from Fort Carson, HQDA and subordinate headquarters, other local military installations, civic leaders, regulatory agencies, and the community. They organized into six teams of 25–35 people each (community well-being, energy and transportation, facilities and installation, materials, training lands and ranges, and sustainability management system) to develop 25-year sustainability goals. The teams produced 12 goals (see Table B.1, which shows each along with the major proponent for the goal). For each goal, the teams defined the problem being addressed, the desired end state, metrics, and intermediate objectives.² Of the 12 goals, the year 2027 goals with energy-related effects aim for the following:

- 100 percent conversion to the use of renewable energy for facilities.
- 100 percent procurement of sustainable products.
- High-performance buildings that use a fraction of the energy currently being used.³

Such sustainability goals have helped provide support for the post's energy program, especially in its pursuit of renewable energy projects.

² Fort Carson, "Fort Carson Sustainability Baseline," Fort Carson, Colorado, August 2002.

³ Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

Table B.1
Fort Carson's 25-Year Sustainability Goals

Goal Number	Goal Name	Description	Proponent
1	Sustainable Water and Energy	Sustain all facility and mobility systems from renewable sources, and reduce the total water purchased from outside sources by 75%.	DPW
2	Sustainable Transportation	Reduce automobile dependency and provide balanced land use and transportation systems.	DOL
3	Improve Communication	Improve communication to foster understanding and attain a "Community of One."	PAO
4	Sustainability Partnerships	Enhance partnering to collaboratively develop, integrate, and implement regional sustainability.	DECAM
5	Hazardous Air Pollutants	The total weight of hazardous air pollutant emissions is reduced to zero.	DECAM
6	Master Plan	Further integrate sustainability principles into the Fort Carson land use planning, Real Property Master Planning, and Military Construction, Army (MCA) programming processes.	DPW
7	Platinum Buildings	All applicable facilities at Fort Carson will be high-performance buildings that meet or surpass the Platinum Standard of SPiRiT or LEED by 2027.	DPW
8	Sustainability Training	Key stakeholder groups are trained, compliant and motivated toward sustainability principles.	SPPO
9	Sustainable Procurement	All DoD and Fort Carson procurement actions support sustainability by 2027.	DOC
10	Zero Waste	The total weight of solid and hazardous waste disposed of is reduced to zero by 2027.	DPW
11	Training Lands	Training Ranges (land and associated air space used for live fire ranges, maneuver, testing and urban development designated for Military Operations in Urban Terrain [MOUT] training) capable of supporting current and future military training to standard.	DPTM
12	Sustainability Management System	Advance a sustainable mission and Fort Carson by adopting an SMS/EMS and by imparting (passing on) a personal commitment and enthusiasm for sustainability.	DECAM

SOURCE: Fort Carson, "Sustainability Program Home Page," U.S. Army Environmental Compliance Division, Fort Carson, Colorado, last modified February 28, 2008.

Because of Fort Carson's long history in sustainability, the energy program and its staff coordinate and interact with the sustainability program staff regularly, and there is overlap in duties and interest, as is discussed more below. Also, the sustainability program has given additional visibility to energy efforts, and many of the core goals of sustainability are now focused on energy. On the other hand, the energy program also has its own responsibilities and activities that do not directly fall under sustainability.

Overview of Fort Carson's Energy Management Program

Fort Carson has had an active comprehensive energy management program for many years that leverages off its sustainability program and emphasizes management, awareness, and project implementation. The installation has won numerous energy awards. In 2003, Fort Carson won a Federal Energy Efficiency/Energy Management Award for implementing energy efficient projects that saved more than \$1.7 million and 42 billion Btu during FY02. One project involved constructing a green building training center that included low-e ENERGY STAR® windows, high-efficiency ENERGY STAR® furnaces, natural lighting, and light-emitting diode (LED) exit signs. Other projects included roof replacements, the installation of energy efficient lighting, and the use of photovoltaics to power water-pumping systems.⁴

Fort Carson also won the Colorado Governor's Renewable Energy Award for 2007 because of its large solar array project and, similarly, a 2008 Secretary of the Army Energy and Water Management Award for Installation Renewable/Alternatives achievements. It has made good progress on meeting goals for energy consumption reduction and renewable energy, detailed below.

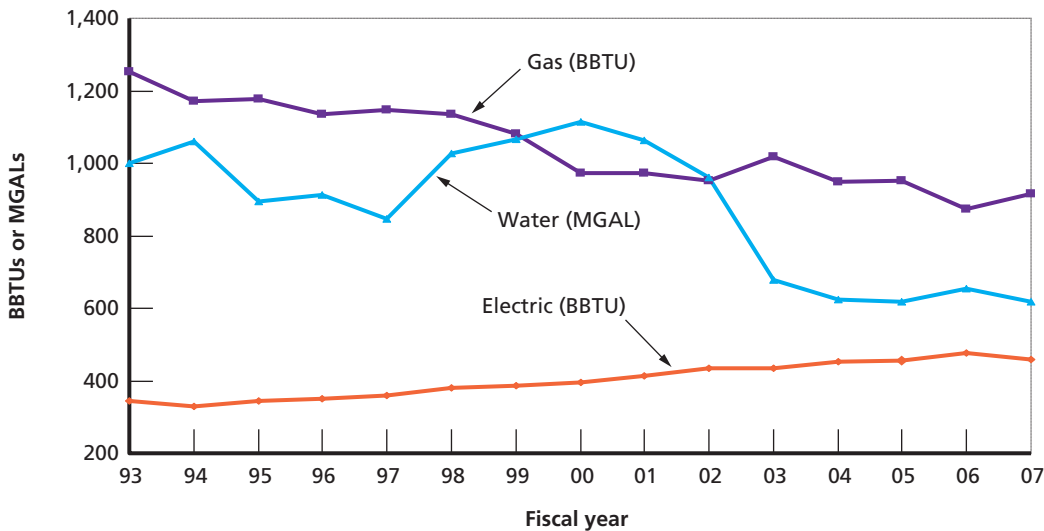
Fort Carson's FY07 utility bill expenses, not including housing, totaled \$11.9 million, which included natural gas (\$4.5 million), electricity (\$6.3 million), and water (\$1.1 million). Figures B.1 and B.2 illustrate Fort Carson's utility consumption and the associated costs from 1993 to 2007. The first chart shows that electricity use has climbed over that period, but that gas and water consumption have fallen.

From FY93 through FY07, electricity costs have steadily gone up and natural gas cost has mostly gone up, as illustrated in Figure B.2. Energy use per square foot has decreased by 8 percent compared to the baseline of FY03. Figure B.3 depicts this decrease over time. In 2008, Fort Carson had 12,865,000 square feet of heated space (of which 9,035,000 square feet is facility space and 3,830,000 square feet is housing space), and it has continued to grow. Despite this growth, the replacement of older, inefficient buildings with new construction that incorporates more energy efficient systems and better insulation has contributed to the trend of decreased energy use per square foot. As a result, Fort Carson's reduction per square foot has been slowly moving toward the Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," goal of 30 percent reduction by the year 2015.

Fort Carson has also been exceeding Army renewable energy goals. In 2002, Colorado Springs Utilities helped Fort Carson identify that roughly 10 percent of the installation's electric power was generated from renewable sources. In an effort to continue this trend, Fort Carson continued tracking renewable energy consumption, as shown in Figure B.4. Increases in 2005 and 2007 can be attributed to the purchase

⁴ FEMP, "2003 Federal Energy and Water Management Award Winners," U.S. Department of Energy, updated March 6, 2006.

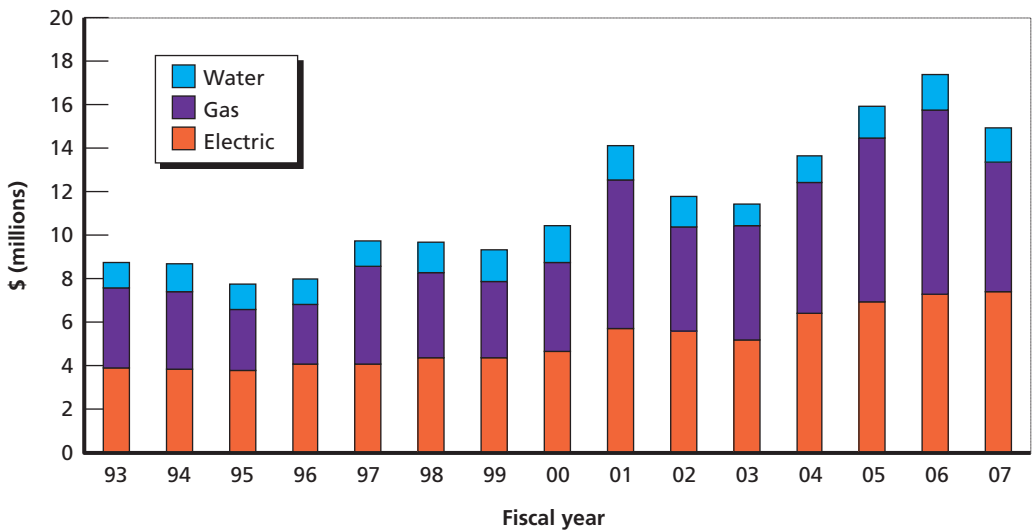
Figure B.1
Fort Carson Utility Consumption (1993–2007)



SOURCE: Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

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Figure B.2
Fort Carson Total Utility Costs (1993–2007)

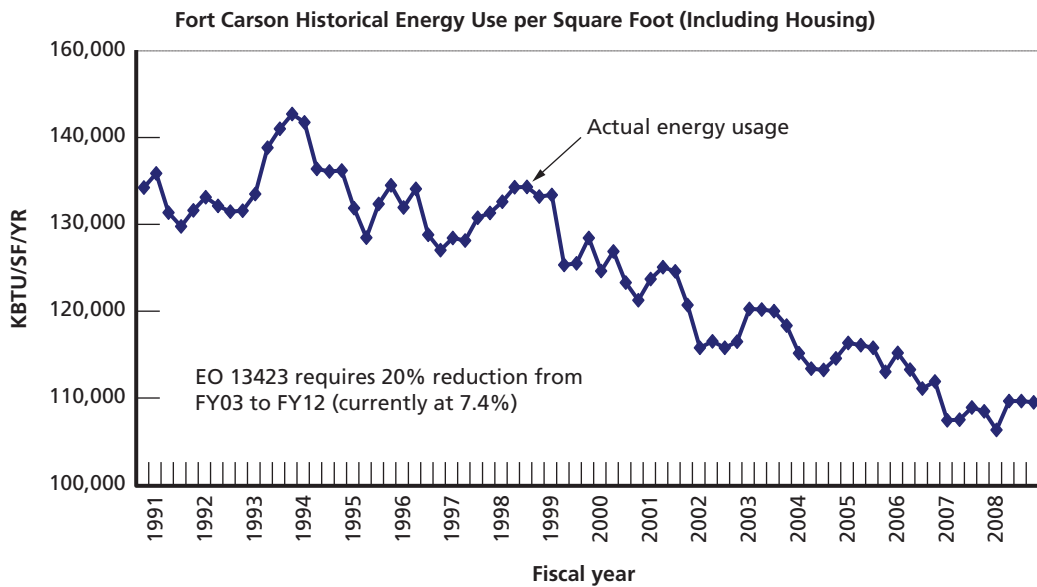


NOTE: Costs are in real dollars.

SOURCE: Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

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Figure B.3
Fort Carson Historical Energy Use



SOURCE: Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

RAND MG1126-B.3

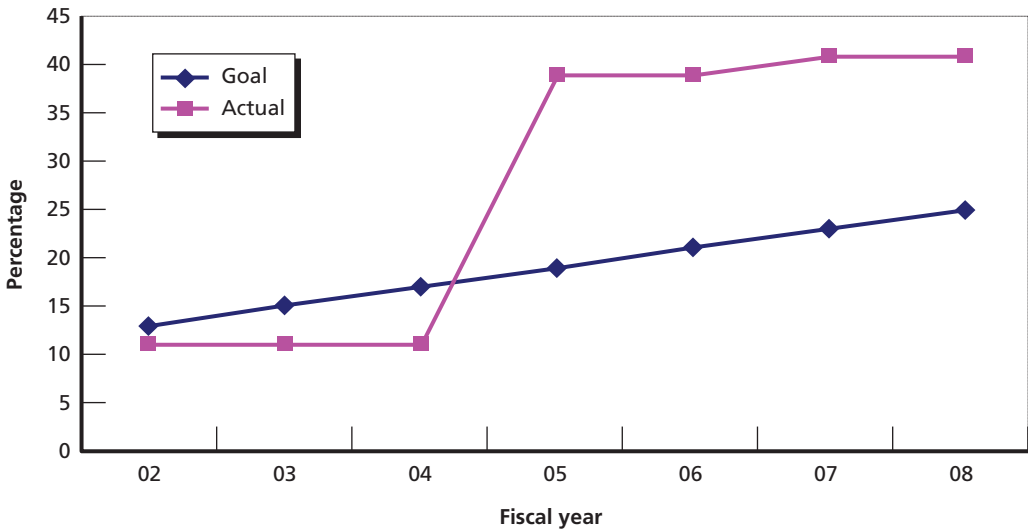
of RECs and the construction of the on-site 2-MW solar array, respectively. These are described in more detail later in this appendix. Figure B.4 also illustrates the extent to which Fort Carson is exceeding renewable energy goals. In 2008, it exceeded its goal by more than 15 percent.

Energy Staff and Staffing Issues

Fort Carson has two main energy management staff positions. The first is an energy program coordinator who is a contractor focusing on energy conservation issues, energy policy, and energy efficiency improvement projects. The second position is a utility program manager who is a federal employee. He deals with utility management issues for the facility, which include billing and tracking, but he also spends a significant amount of time supporting utility and energy improvement projects as well as exploring renewable energy opportunities. These energy staff members also lead energy-related efforts under the sustainability program.

The aggressive sustainability program at Fort Carson has helped provide more visibility and staff support—including garrison commander support—to help on energy program projects. Having a 100 percent renewable energy goal as part of the installation's sustainability goals is especially helpful. In fact, the garrison commander has

Figure B.4
Fort Carson Renewable Electric Energy Consumption (2002–2008)



SOURCE: Fort Carson, “Energy Management Plan (EMP), Fort Carson, CO,” Fort Carson, Colorado, September 2008.

RAND MG1126-B.4

helped ensure installation staff support as the energy team has pursued renewable energy projects.

Fort Carson’s Relationship and Collaboration with Its Utilities

Colorado Springs Utilities (CSU) is Fort Carson’s primary supplier, providing over 90 percent of its utilities, including water, electricity, and natural gas and excluding only sewer. However, Fort Carson also has relationships with Xcel Energy, Black Hills Energy, and Western Area Power Administration (WAPA). Here we discuss some of Fort Carson’s collaboration with CSU and then with these other utilities.

CSU works closely with Fort Carson in a range of areas, including providing free energy audits, classes, and technical assistance. CSU energy audits for Fort Carson have included an audit of Fort Carson’s data center, where CSU provided, at no fee, recommendations for energy efficiency projects. Personnel at Fort Carson have also attended classes given by CSU. These classes include topics such as energy conservation, boiler classes, and xeriscaping, and Fort Carson energy management staff typically attend about two of these classes a year. CSU also participates in a Fort Carson energy awareness outreach, such as having an information booth at the sustainability conference.

CSU has a liaison who deals with Fort Carson. CSU also has either quarterly or annual meetings with its large commercial customers, including Fort Carson. Fort Carson also participates in CSU's Electric Integrated Resource Planning (EIRP), which does strategic planning for the region.

CSU has some solar rebates available, but they are unpredictable because CSU often runs out of its rebate funding. In 2009, CSU's solar rebate budget was gone in two months. It is never clear when or if the rebate will be there.

Fort Carson has approached CSU about collaborating in a UESC on several occasions. Thus far, CSU has not been interested in this type of collaboration.

Xcel Energy is a publicly owned utility supplier of electric power and natural gas service in eight states: Colorado, Michigan, Minnesota, New Mexico, North Dakota, Texas, South Dakota, and Wisconsin. Xcel Energy has a program called "Solar*Rewards" that provides cash back for installing a solar photovoltaic system on one's home or business.⁵ Xcel Energy was a key partner in the large solar array project (discussed below). Xcel Energy is purchasing the RECs from this array for 20 years under the Solar*Rewards program.

Black Hills Energy is a publicly owned utility supplier that provides electric services to approximately 93,300 customers in southeastern Colorado and natural gas utility services to approximately 524,000 customers in Colorado, Iowa, Kansas, and Nebraska. Black Hills Energy is owned by Black Hills Corporation. Black Hills Energy has a good solar rebate system. Fort Carson put in a proposal to do an ECIP for a 100-kw solar array in 2011 to take advantage of this rebate. Fort Carson would be able to get this rebate because it is not a federal rebate. It used rebates in the cost analysis of the potential project to make it more economically attractive.

WAPA has also been an important partner for Fort Carson, selling RECs to the installation and helping facilitate the large solar array project. In fact, as Fort Carson staff wrote, "The Fort Carson 2 MW photovoltaic array and the REC purchase would not have been possible without the outstanding support received from WAPA. WAPA provided the customer support and guidance necessary to complete these projects in a timely and efficient manner."⁶

Fort Carson's Participation in Energy Working Groups

Fort Carson participates in two regional military energy management working groups: the Regional Utility Working Group (RUWG) and the Front Range Renewable Energy Consortium (FRREC). These groups are working to promote energy efficiency

⁵ More information on Solar*Rewards is available at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CO12F&re=1&ee=1.

⁶ Fort Carson, "Supplemental Information: 30th Annual Secretary of the Army Energy and Water Management Awards: FY07 Accomplishments for Fort Carson," 2008.

and renewable energy technologies at military installations in Colorado. We briefly describe each and the role of utilities in them.

Regional Utility Working Group (RUWG). RUWG meets monthly and is made up of local military organizations and military personnel, including representatives from Peterson Air Force Base, Shriever Air Force Base, Cheyenne Mountain Air Force Station, Buckley Air Force Base, and the Air Force Academy. The group continues to grow and meets to talk about potential energy efficiency projects. The local utility company has also expressed interest in participating, and GSA is involved as well. The RUWG has reached out to CSU to see how it might support other renewable energy projects.

Front Range Renewable Energy Consortium (FRREC). FRREC is a subgroup of the RUWG. It examines issues such as identifying regional targets for renewable energy projects and determining plans for implementation. PNNL has been brought into these meetings, as have representatives from the Colorado governor's energy office. The group decided that the target project would be concentrated solar power in the 200-MW range. Utility companies do not tend to participate in the FRREC, although they are kept informed of group activities.

Funding Issues

Fort Carson has tried ESPCs, but the energy staff and management have found it to be an expensive tool and Fort Carson prefers to invest post dollars. Fort Carson has been fairly successful in the last several years securing funds either through post dollars or under ECIP to fund projects such as lighting retrofits, boiler replacements, energy management system upgrades, and some small renewable energy projects. Fort Carson has also used operations dollars to complete some smaller energy efficiency projects. Fort Carson continues to push for and complete projects that have both energy efficiency and maintenance cost-reduction benefits to get the best bang for its buck.

Fort Carson Renewable Energy Projects

Because of its strong sustainability program, Fort Carson staff, including senior management, are heavily committed to investing in renewable energy activities given concerns over climate change, issues with regional air quality and water, and the post's commitment to environmental stewardship. Fort Carson's 2008 Energy Management Plan outlines the following strategies to meet renewable energy goals:

1. Renewable Energy Credits (RECs) will be purchased from available sources, such as WAPA, which meet cost-effectiveness criteria.
2. Renewable energy technologies will be investigated for distributed generation opportunities and for integration into facility designs.

3. Renewable energy will be requested from utility providers to expand the utility portfolio for Fort Carson.
4. On-site renewable energy opportunities will be investigated and implemented where cost-effective.⁷

Fort Carson has used these strategies to pursue its large solar array project, to purchase RECs, to install a solar wall, to pursue wind energy, and to engage in other renewable energy activities. Below we briefly describe some of Fort Carson's renewable energy projects. In many cases, utilities played a role in these activities.

Ground-Mounted Solar Photovoltaic Array Project

In FY07, Fort Carson started building a 2-MW ground-mounted solar photovoltaic array on 12 acres atop a former landfill. It is the largest solar array at a U.S. Army facility and one of the largest in Colorado. See Figure B.5 for a photo of this array. While the array became operational in early FY08, planning, coordination, and construction began in FY07. The photovoltaic array generates 3,200 MWh/year and provides Fort Carson with nearly 3 percent of the installation's electrical needs.

Figure B.5
Fort Carson Two-MW Solar Array



SOURCE: Photo courtesy of Fort Carson.

RAND MG1126-B.5

⁷ Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

In working toward the Colorado Renewable Portfolio Standard (RPS), which requires utilities to obtain 20 percent of electricity from renewable sources by 2020, and its renewable energy goals, Fort Carson pursued a project to develop this large ground-mounted solar photovoltaic array on post. Fort Carson partnered with Xcel Energy for the project, which was able to receive credit for the project through RPS, although Fort Carson is serviced by CSU. For this project, Fort Carson used a power purchase agreement (PPA) through WAPA as the contracting vehicle, and it was for a 20-year term. Xcel Energy bought Fort Carson's renewable energy credits (RECs) for 20 years under its Solar*Rewards program, which provides incentives for residential and commercial solar installations.

Morgan Stanley financed the solar array project and thus owns it, but it has another entity run the project. 3Phases Energy Services, LLC served as the broker on the project, got Morgan Stanley on board, and pulled all of the pieces together. 3Phases Energy Services, LLC and Sun Technics Energy Systems, Inc. developed, engineered, and installed the array on leased Fort Carson land. The solar panels use a thin-film photovoltaic technology.

Xcel Energy was instrumental in making the project happen. Colorado has RPSs for 20 percent renewables by 2020. Additionally, publicly owned utilities in Colorado must reach a 4 percent solar energy requirement by 2020, and Xcel falls under this standard. It is getting very competitive to find projects that have a good REC value. Xcel put out an RFP for the RECs, and three or four developers contacted Fort Carson about doing the project and energy staff entertained all of them, finally choosing the one that was awarded an Xcel REC contract.

Fort Carson is purchasing the energy from Carson Solar I, LLC at a fixed rate of 5.5 cents per kilowatt-hour for the duration of the contract and will save an estimated \$500,000 in utility costs from projected utility rate increases. After 20 years, a new agreement must be negotiated for the array. The agreement will be revised, and there will be better rates and better solar technology by that time. The current contract topped out at two megawatts, so no additional solar panels can be added. But a new contract in the future could change that restriction and allow for some additional space for more solar panels.

The state tax credits for solar energy helped this project get funded as well. Solar array structures are expensive. The project cost \$13 million. The developer receives a 30 percent federal tax credit and pays for almost 40 percent of the project over its life. All the front-end development costs were rolled into the price of the power. It did not make sense for the Army to own the array, since it could not receive this federal incentive.

In this deal, Fort Carson leveraged the value of the land to get a good fixed price on energy and kept the Army costs down as well. The Fort Carson site was an underutilized asset in the form of 12–15 acres. They used a flat lease, surface only, for the deal. Omaha USACE had responsibility for the lease, sending it to IMCOM West and then to headquarters for review, at which point ACSIM energy staff helped push the

lease through and get it approved. If the Army charges for leases through a standard EUL deal, then it cannot get a competitive price for RECs. If it costs the developer 18 cents for RECs on Fort Carson while the market value is 14 cents, the developer will not want to pay for the land as well. If the primary purpose is to extract the value of the land for the Army, then an EUL will work. But this is not the case if the primary objective is a renewable energy project, as at Fort Carson.

The upfront out-of-pocket cost of this project, excluding the development cost, was \$20,000, which was the price for the PPA, the paperwork required for the lease, and the environmental documentation. All of this was accomplished in less than three months, which is much faster than an EUL deal. Fort Carson paid less than \$10,000 for the PPA, and WAPA probably lost money on the deal. However, for WAPA, the PPA deal has guaranteed delivery of power and helps meet federal renewable energy goals.

Because this project site covered nearly 12 acres atop a former landfill, the project required a significant amount of environmental review, paperwork, and some additional special requirements. A two-foot concrete cover had to be poured on the landfill and the array slopes on the concrete ballasts. Environmental staff were supportive of the project and helped make sure the environmental issues were dealt with efficiently.

Fort Carson uses the energy from the solar array, but sold the RECs to Xcel for 20 cents per kilowatt-hour. It is unclear whether Fort Carson gets credit for the RECs toward its federal renewable energy goals. Fort Carson could get a single credit for EPCa. The Army says this supports Fort Carson's renewable energy goals, but the installation cannot get credit for EPCa because this would be double counting.

CSU has also been supportive of the solar project. The energy that is generated by the array relies on CSU for transmission and being part of the local utility grid, i.e., CSU hosts the photovoltaic array on its grid. CSU is also helping provide O&M. Fort Carson can not be considered an island within CSU's service area, because if the grid goes down, the array goes down. However, there is always some degree of energy security with renewables, but in this case it is indirect.

Renewable Energy Credit Activities

In 2005, Fort Carson partnered with eight other government agencies in an agreement with WAPA, which allowed a five-year REC purchase of 40,000 MWh/year, approximately 28 percent of Fort Carson's annual electrical consumption. Fort Carson made this purchase as a way to kick off the renewable energy program, but will not be buying RECs again. The Army's position on this is that Fort Carson can sell the RECs if needed and down the road can buy cheaper RECs to replace those sold to meet energy goals.

Biomass from California sawmills provides 76 percent of the RECs, and the remaining 24 percent comes from wind farms located in California and Nebraska. The RECs give Fort Carson credit for supporting renewable energy production and are one way that Fort Carson made immediate progress toward its 2027 goal to achieve 100 percent renewable energy. Additionally, promoting renewable energy helps decrease the

demand for finite and potentially less environmentally benign nonrenewable energy sources such as coal and natural gas. Fort Carson is a U.S. EPA Green Power Partner and is one of the top ten federal purchasers of RECs in the United States.⁸

Transpired Solar Collector Wall

Based on a 2003 study, Fort Carson submitted an ECIP proposal for a transpired solar collector wall project. This ECIP project was funded in FY06 and installed by spring 2007. A large transpired solar collector wall was planned and constructed for Building 8030. See Figure B.6, which shows this solar wall being installed. The transpired solar collector preheats intake air for the building from 12,000 square feet of metal perforated walls on the south side of the building, which in turn reduces the amount of natural gas needed to heat the building. This solar wall has been estimated to annually save Fort Carson about 7,000 MBtu and \$35,000 in reduced natural gas costs; it cost an estimated \$350,000 to install.⁹

Figure B.6
Installation of Fort Carson Solar Wall



SOURCE: Photo courtesy of Fort Carson.

RAND MG1126-B.6

⁸ Fort Carson, "Supplemental Information: 30th Annual Secretary of the Army Energy and Water Management Awards: FY07 Accomplishments for Fort Carson," 2008.

⁹ Fort Carson, "Supplemental Information: 30th Annual Secretary of the Army Energy and Water Management Awards: FY07 Accomplishments for Fort Carson," 2008, p. 2.

Wind Projects

Fort Carson and the Colorado National Guard partnered with the National Renewable Energy Laboratories (NREL) to install a 50-meter meteorological tower on the southeast portion of Fort Carson. By analyzing wind resource charts and discussing opportunities with NREL, an optimum site was selected to determine potential wind resources at Fort Carson. This tower has been used to collect wind data to help determine the feasibility of wind power at Fort Carson.

Initial wind tower data and an assessment by PNNL in 2008 determined that Fort Carson has fair wind resources and will continue to evaluate the feasibility and economics of a wind turbine project. At that time, however, the cost of commercial power that would be avoided by wind generation was 3.86 cents per kilowatt-hour, which was much lower than the estimated costs from a wind generation project at 10.45 cents per kilowatt-hour. The savings-to-investment ratio (SIR) for an ECIP wind farm project at Fort Carson would be 0.5, and the payback would be 29.4 years. Renewable energy incentives and higher utility rates by CSU could make the project more economically feasible. CSU rates have gone up some since this study was done. In addition, finding a buyer for the RECs from a Fort Carson on post wind farm could bring the price down significantly, as it did for the large solar array project. However, RECs for wind power are sold at a lower price than for solar power because of the solar set-aside provision in Colorado's RPS. According to the PNNL study, economic feasibility is dependent upon RECs selling for at least 7.0 cents per kilowatt-hour.¹⁰

Despite the economic obstacles, Fort Carson is interested in building a 7–10 megawatt wind farm. Fort Carson has had challenges with wind energy but is working through them, and the renewable energy staff have installation staff support. For instance, the installation sustainability staff are helping with the project. The issue of potential radar interference with training operations has come up as a concern. However, Fort Carson should not run into a radar problem unless it builds a wind farm of an extremely large size. There are also some community relationship concerns with neighbors regarding this wind farm, which can present a challenge to such a project. Since it is a smaller wind farm, Fort Carson will not have to rely on its utility partners because it has its own transmission line that can handle that amount of wind energy.

¹⁰ For more details on the wind analysis, see W. D. Chvala et al., "Renewable Energy Opportunities at Fort Carson, Colorado," PNNL, U.S. DOE, PNNL-18132, December 2008.

Fort Knox Case Study

This appendix provides a summary of some of the ways that Fort Knox has been collaborating with utilities, most notably its successful and extensive UESC implementation. It is designed to be a detailed installation story that illustrates many of the issues raised in the main text as they have played out at Fort Knox. To set the context, it begins with an overview of Fort Knox and its energy program. Then it briefly describes the post's energy staff and how it interacts with its utilities. Next it describes Fort Knox's UESC process and some of its UESC projects. This section ends by briefly discussing some other energy projects at Fort Knox.

Overview of Fort Knox

Fort Knox is located about 35 miles south of Louisville, Kentucky and about 15 miles north of Elizabethtown. The post covers over 109,000 acres or about 170 square miles and parts of Bullitt, Hardin, and Meade counties. Fort Knox is the sixth-largest city in Kentucky based on population and is home to over 23,000 soldiers, family members, and civilians. Units located on Fort Knox at the time of our study included active-duty Army organizations, Army Reserve, National Guard, and the Marine Corps. Fort Knox is the home of the Army Armor Center and Army Recruiting Command. It has been used by both the Army and the Marine Corps to train crews on the M1 Abrams main battle tank. The Army Accessions Command has personnel on post and will relocate its headquarters there as a result of the BRAC decisions of 2005.¹

In 2008 there were about 2,300 buildings on post, including its famous gold vault (the Fort Knox Bullion Depository),² the Ireland Army Hospital, and privatized housing with about 10 million square feet of space. As a result of BRAC and new con-

¹ The tenants at Fort Knox, as at most installations, are in flux. As of late 2010, the Armor Center was in the process of moving to Fort Benning, Georgia, while Accessions Command and Human Resources Command were scheduled to move in. All of these moves are from BRAC decisions made in 2005.

² Since the gold vault and the land it is on are owned by the U.S. Department of Treasury, its energy consumption is not included in Fort Knox totals.

struction, Fort Knox building square footage was scheduled to increase by about 20 percent by the end of 2010.

Overview of Fort Knox's Energy Program

Fort Knox has had an active energy management program for over 20 years. The program has focused on reducing energy consumption and keeping its customers comfortable and happy. Over the years Fort Knox has won numerous energy management awards and has made significant progress in reducing its energy use intensity (EUI) through energy projects that were funded mostly by UESCs with Nolin Rural Electric Cooperative Corporation (RECC). Widespread use of ground source heat pumps (GSHPs) has been another strength of Fort Knox's program. Awards won have included a 1997 Army Energy Conservation Award, a 2003 Army Energy and Water Management Award, a 2006 Federal Energy and Water Management Award, and a 2007 Federal Energy and Water Management Award.

The 2007 award was in the category of Renewable Energy Awards to Organizations, and its description provides a nice overview of the types of achievements Fort Knox's energy program has had. Through its UESC program, Fort Knox renovated heating, ventilation, and air conditioning (HVAC) in a barracks complex consisting of 12 facilities with 376,000 square feet. The project replaced three inefficient, centralized high-pressure, high-temperature hot water systems with GSHPs. In addition, the barracks complex was updated with wireless automated ventilation systems to improve indoor air quality.

This project, combined with installation of other energy efficient technologies at the base including high-efficiency lighting and exit signs, infrared heating, cool insulated roofs, photovoltaics, and solar domestic water heating, reduced natural gas use in FY 2006 by almost 65 billion Btu—6 percent from the previous year and 27 percent since FY 2003. This is equivalent to the energy needed to power about 680 homes and replace more than 12,000 barrels of oil.³

Besides having a strong UESC program and utility partner, experienced energy staff, garrison, and other installation support have been key to the energy program's success, as is discussed below. Another thing Fort Knox has done to help its energy program is to put together energy design guidelines for contractors. However, these are not always followed. For example, with MILCON projects, USACE designers often include the desired energy efficient systems, but the USACE construction staff sometimes cuts them out when there are cost-overrun problems during construction.

³ FEMP, "2007 Federal Energy and Water Management Award Winners," U.S. DOE, November 6, 2007.

Energy Staff and Staffing Issues

The Fort Knox energy management office has two energy staff: an energy manager who is a GS-12 position, and an experienced REM.⁴ The energy manager has been at the post since spring 2008. In fact, the REM used to be the energy manager at Fort Knox. He retired in August 2007, after 20 years of working at Fort Knox, and was hired as REM in September 2007. The REM's salary is paid through a UESC contract, and he is expected to save his yearly salary in energy savings.

The energy manager reports directly to the engineering and services division chief of the Directorate of Base Operations Support, a part of the garrison commander's office. The energy management office includes responsibilities to energy management councils/committees and to those responsible for facility/building management, energy management, O&M, retrofits, new building design, contracting for performance-based contracts, analyzing utility bills, and leasing of space.

The garrison commander and energy manager are now specifically rated as part of their performance evaluations on energy use.

Fort Knox's Relationship with Its Utilities

Fort Knox has a good working relationship with its three utilities: Nolin Rural Electric Cooperative Corporation (RECC), Louisville Gas and Electric, and Mead County RECC. Nolin RECC is Fort Knox's utility privatization contractor for electricity and maintains the power lines. Nolin RECC is the utility that Fort Knox has partnered with in UESCs. Fort Knox has a strong working relationship with Nolin RECC, having partnered with it since the mid-1990s.

Both energy staff from Fort Knox and Nolin RECC mentioned how there were synergistic benefits from the UESCs and working so closely together. For instance, now Nolin RECC also maintains the electrical meters for Fort Knox and provides quick service to repair them. However, when the natural gas meters break down, the energy program needs to scramble to find funding to get them fixed.

Nolin RECC has also provided energy-related classes for Fort Knox staff and energy audits. It has conducted a safety class for Fort Knox firemen and schools. The utility also participates in some Fort Knox community events, such as providing a booth at Fort Knox's Morale, Welfare, and Recreation (MWR) day providing safety information for children and their families. Nolin RECC has an office on post, and its vice president is often available there to meet with contractors and post staff. In fact, in many ways Nolin RECC and its contractors are integrated into the Fort Knox energy management community, providing on-site support in operations, maintenance, and technical assistance.

⁴ The REM serves as a contractor who works for the government, in this case the Army, and is effectively paid by the Army through the UESC contracting mechanism; the salary of the REM is covered by self-generated energy-related savings, as stipulated in the contract.

The UESC Program at Fort Knox

Fort Knox has the most experienced UESC program within the Army. By fall 2008, 91 UESC projects had been completed or were just being started. By 2002, Fort Knox had invested nearly \$18 million in UESC projects, including numerous delivery orders. From FY96 to FY06, 70 UESC projects were implemented. The first energy efficiency projects in 1996 and 1997 mostly had to do with lighting. Over time, the projects have become larger and more complex and are often bundled together to meet the 10-year payback requirement. Projects have included GSHP installations, boiler upgrades and replacements, more lighting retrofits, window/roof replacements, HVAC system replacements, occupancy sensor installations, high-efficiency motor retrofits, and photovoltaics. After each project is approved and implemented, Fort Knox repays the loan over a 10-year period as part of its electricity bill. As with all UESCs, Fort Knox's project costs are offset by the energy savings generated by the retrofits.

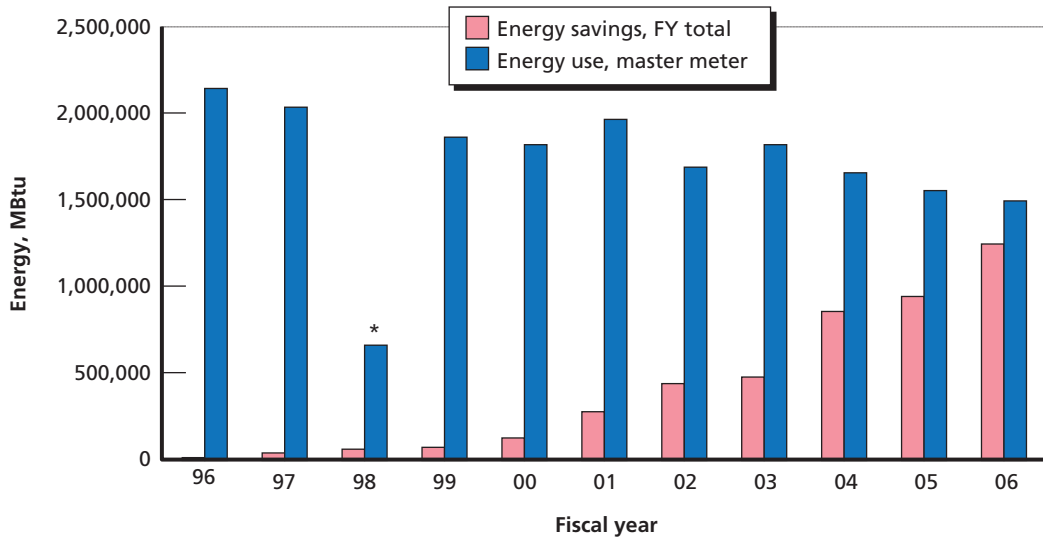
Since FY06, over 20 new UESC projects are either being developed or implemented at Fort Knox. Fort Knox's ongoing relationship with Nolin RECC and its contractors has enabled an accelerated pace in developing new task orders and in implementing and completing projects.

In the 10-year period between FY96 and FY06, Fort Knox had a 58 percent reduction in absolute energy use, mostly because of its UESC projects. Figure C.1 shows the total energy savings compared to energy use for natural gas and electricity during this period, from the installation's master meter data. The chart appears to show that without the UESC collaboration and investments, Fort Knox would have used almost twice as much energy in 2006 compared to 1996, which would have cost this post almost double what it pays now. However, it is important to point out some caveats with the data. There are some limitations with historical energy use comparisons at Fort Knox (and Army installations in general). Such data do not account for changes in total square footage on the installation or in individual building usage. The data also include "billable customers" not involved in energy improvements. The lack of meters on individual buildings and facilities makes it hard to correlate changes in master meter data with a specific project. Given such limitations, the savings may not be quite as high—or they might even be higher—but the data do show that energy use has gone down significantly.

It is also worth noting that electricity use has gone up slightly during this time period, while natural gas use has gone down significantly. This difference is for two main reasons: GSHPs save significantly on natural gas consumption, but use some electricity, and electricity demand has been increasing because of the increase in the use of this and possibly also other electrical equipment.

Fort Knox's historic and anticipated cost savings are shown in Figure C.2. This figure shows the net dollar savings out to 2020 assuming new projects stop in 2006 and the last payment on capital is in 2020. It shows cost savings from energy savings

Figure C.1
Fort Knox UESC Projects Total Energy Savings Compared to Total Energy Use
(Natural Gas Plus Electricity)



*Total energy use data not available for FY98. Value is for electricity only.

NOTES: (1) These data are based on “stipulated and measured factors”: (a) spot measurements taken at component and system level; (b) stipulation supported by historical and/or manufacturer’s data; and (c) savings estimated through engineering calculations, component, or system models. (2) Projects are binned by FY, but the actual start and completion dates, and resulting energy savings, may be shifted by several months relative to presentation herein.

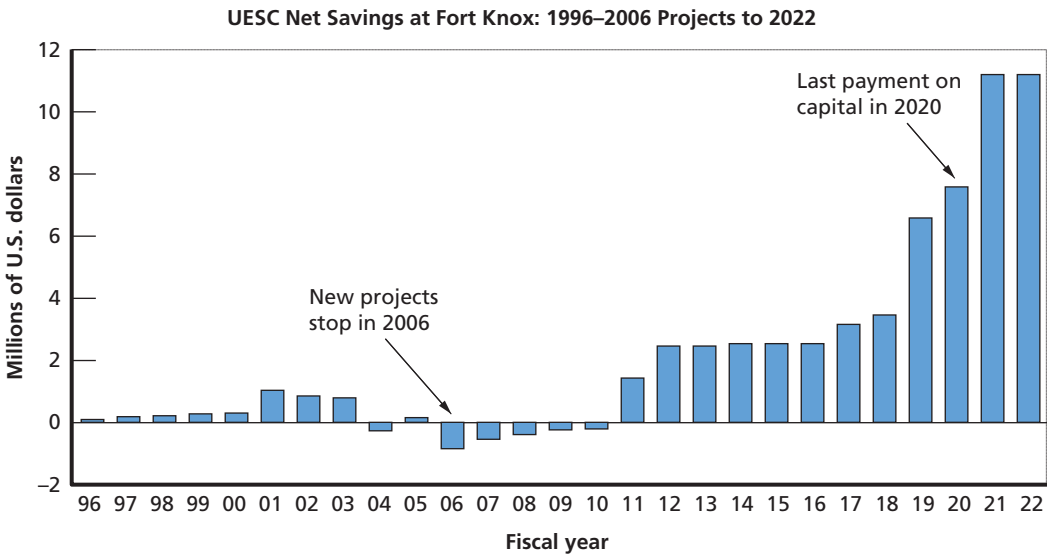
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minus payment costs. Again, the same caveats apply. Savings are negative in 2006 and a few years after that because there was a large UESC investment made in HVAC maintenance in 2006. These data are based on “stipulated and measured factors.” The data assume O&M costs will go to zero at the end of the UESC contract. However, O&M paid by the utility during the period of the contract must be borne by the Army after the last contract year, so additional O&M costs for the Army would apply after 2020.

Overview of the UESC Process

Fort Knox started small with its UESC process. Initially it was difficult, but once success was demonstrated, it became much easier to develop and implement UESCs. Senior management support from the garrison commander’s staff has been important. Now, with years of experience and collaboration, Fort Knox and Nolin RECC have an efficient and fast process for implementing UESC projects. They have a BOA, “Fort Knox Electric Service Contract with Nolin Rural Electric Cooperative Corporation for Demand Side Management and Energy Efficiency Services,” that is the foundation

Figure C.2
Fort Knox UESC Project Historic and Anticipated Savings



RAND MG1126-C.2

for the UESC process. This contract has been modified and updated over the years as needed, most recently in 2006. Using this contracting vehicle, Fort Knox can fairly quickly put together tasks and delivery orders to implement UESC projects.

Potential UESC projects are identified by ongoing energy audits, as well as by energy program and other installation staff. For example, staff may decide to do a UESC project when an old HVAC system fails and needs to be replaced to put in a new, more energy efficient system. Fort Knox has been trying to do energy audits on about 10 percent of the buildings each year. These audits are done by a wide range of organizations, including Nolin RECC, contractors, USACE CERL, USDOE Laboratories, and installation staff. For example, PNNL conducted an installation-wide energy assessment of Fort Knox in FY04 that audited a representative sample of 36 post buildings for energy efficiency opportunities, which was then used to help identify UESC projects.

Financing Rates and Other Financial Issues

An important part of a successful UESC is having low financing rates that make it economically feasible and attractive. An advantage Fort Knox has with Nolin RECC as a partner is that as a rural electric cooperative, it can provide low-interest-rate financing from the National Rural Utilities Cooperative Finance Corporation for its energy efficiency and renewable energy projects. The monthly variable interest rate Nolin charges Fort Knox has been less than 4 percent. Over the years Fort Knox has had good financ-

ing rates, ranging from as low as 3 percent to as high as 7 percent, depending on the market rates on its UESC projects. This rate rose above 7 percent only once between 1997 and 2002. In August 2008 the financing rate was 4.9 percent, and in November 2008 it was 5.4 percent. Interest payments form a significant portion of financed projects, so the low rates available through a UESC with rural electric cooperatives can be a great deal for Fort Knox and other Army installations.⁵

Fort Knox also has the opportunity—and has been able—to buy down some of its debt on UESC project investments. When the installation pays off some of its debt earlier it avoids some interest payments, which lowers the bills overall.

Fort Knox starts paying for each UESC project before it is operational, but it only pays interest on what has been spent to date. Fort Knox does not have to pay full interest until the project is operational. This is an advantage compared to other installations' UESC agreements, where they pay the full interest before the system is operational.

Another advantage of Fort Knox's UESC process is the ability to take and process year-end funds quickly. Often, federal agencies end up with funding at the end of the fiscal year that has not been obligated, and if they do not obligate it they will lose it. In 2006 and 2007, ACSIM had significant unexpected end-of-year funds in late September that it was not going to be able to spend. This money was made available to Fort Knox because ACSIM staff knew that the installation could apply it to its UESC contract within a few days. Accordingly, Fort Knox used the money to pre-pay and buy down some of its UESC debt.

Operations and Maintenance (O&M)

Ensuring that proper O&M is performed so that energy efficiencies and savings are achieved has been important to Fort Knox's UESC success. Initially, Fort Knox relied on installation staff for O&M in UESC projects. However, the installation experienced problems with this service because the in-house staff did not have the required knowledge to perform O&M on the new equipment. O&M is now outsourced and its cost is built into UESC task orders, which include the "performance" of equipment and maintenance. In fact, at around \$12 million, the largest UESC-funded project at Fort Knox included this maintenance, which covers about half the maintenance for the entire installation. The energy office and DPW pay for this maintenance through the UESC contract. The contractors are required to keep the systems up and running for 10 years/life of the equipment. At the end of that time, Fort Knox would need to negotiate a new maintenance contract.

The O&M work is performed via Nolin RECC through experienced Trane contractors. Trane has trained and experienced staff located on the installation. In August

⁵ FEMP, "Fort Knox Strikes Energy-Savings Gold in Innovative UESC Partnership," *FEMP Focus*, May/June 2002.

2008, there were 14 to 15 Trane technicians, with several trucks for dispatching technicians for service calls and troubleshooting.

Monitoring and Measurement and Verification (M&V)

Ongoing monitoring has been an important part of Fort Knox's UESC program, as well as its energy program. As will be discussed in the EMCS section later, buildings that have UESC retrofit projects in them and new construction are monitored through the installation's EMCS, which provides detailed information about temperature and heating and cooling system operations. Over time, Fort Knox has included the cost of its monitoring system installation and staff in UESC task orders. The on-site monitoring for most projects is by the UESC contractor, usually Harshawe-Trane.

Building commissioning also helps ensure that Fort Knox systems are calibrated and functioning properly. Fort Knox tries to perform "building commissioning for every new and renovated structure to ensure optimal functioning of energy using building systems." It is included in UESC and MILCON projects. "In this age of ever more complex high tech building systems the commissioning and continuous commissioning has to be accomplished to keep proper comfort for occupants and reduce energy consumption."⁶

Fort Knox has no formal M&V program. It relies on its efficient monitoring system, timely O&M, and building commissioning to ensure that its buildings are achieving the expected energy savings. Some informal M&V data have been collected and analyzed for selected building systems, like the hospital boiler-chiller replacement project. Close tracking of utility bills for different buildings by energy staff also serves as an informal check on system performance.

Tenant Issues

Like many large Army installations, the Fort Knox energy program has many tenants, such as MEDCOM and Army and Air Force Exchange Service (AAFES), whom they bill for utility use. In 2005, Fort Knox had about 54 utility-reimbursable customers.⁷ These customers' meters are read⁸ and they must pay the budget office for this consumption, which pays their part of the post's master meter utility bill. All AAFES facilities, including the commissary (which is run by the Defense Commissary Agency (DeCA) but occupies a building managed by AAFES), seven other retail facilities, and 10 food facilities and 29 concession operations, are metered, and AAFES is billed monthly for their utility consumption.

⁶ Fort Knox, "Long-Range Energy Management Plan: Fort Knox, Kentucky," March 28, 2005, p. 17.

⁷ For more information about these utility-reimbursable customers, see Fort Knox, "Long-Range Energy Management Plan: Fort Knox, Kentucky," March 28, 2005, p. 12.

⁸ In 2005 most of these customer buildings were metered, but not all.

Such tenant's buildings and their energy consumption is usually included in the Fort Knox total energy usage statistics, so the energy program would like to see these tenants invest in more energy efficiency systems and reduce their energy consumption. However, they often do not want to use their own funds to do so. Fort Knox has been successful at persuading some of these tenants to invest their own money into UESC projects with Nolin RECC. In FY04, AAFES entered into a UESC project in collaboration with the energy program to make two of its buildings housing its main stores more energy efficient. AAFES pays the lower monthly utility bills and the debt service on this UESC project. MEDCOM has participated in a UESC for its hospital boiler-chiller replacement project (discussed later) and a few other UESC projects in collaboration with Fort Knox energy staff and Nolin RECC.

UESC Projects

Since Fort Knox has implemented, or has in process, at least 91 UESC projects, we only briefly mention some of them here. Many of the projects have included GSHPs, so we first summarize this project experience. Then we briefly discuss the EMCS, the Disney Barracks, the hospital boiler-chiller replacement, natural gas extraction, and lighting projects. We should note that one or two renewable energy projects have also been funded through UESCs, but these are discussed later under a separate heading.

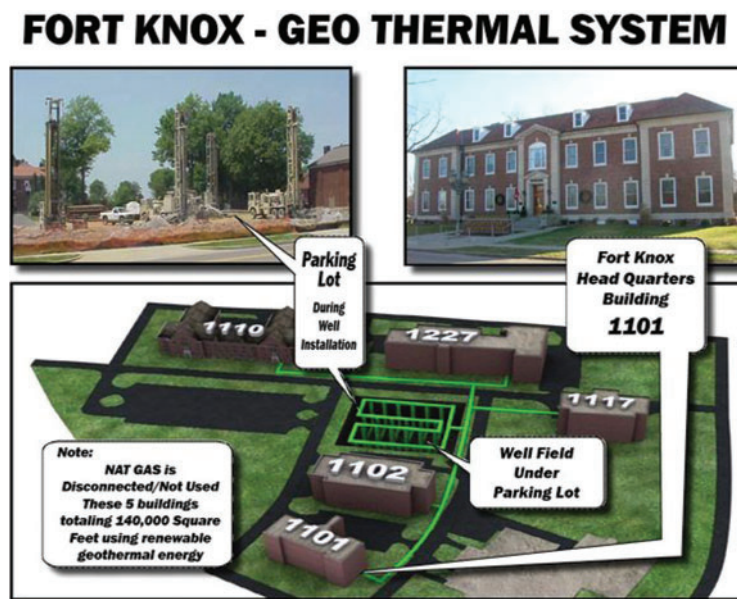
GSHP Projects

The most successful energy conservation measure at Fort Knox has been the installation of GSHPs, mostly through UESCs. By the end of FY06, about 25 percent of the installation's facilities were using GSHPs. By August 2008, about 50 percent of Fort Knox's total building square footage, about 5 million square feet, was heated and cooled by GSHPs in over 250 buildings and using about 118 GSHP systems.

GSHPs are renewable energy systems that provide heating and cooling by taking advantage of 57°F ground temperature by pumping water through pipes underground to transfer the heat/cooling. Wells and piping are laid underground often under parking lots or green spaces near the buildings to circulate the water. Figure C.3 shows a diagram of the well system under a parking lot for five buildings at Fort Knox. The green lines in this diagram show the piping and the well system. One GSHP system can serve one or multiple buildings; the latter is shown in this figure.

Fort Knox started using UESCs to help install GSHPs. By the end of FY06, GSHPs had demonstrated significant energy savings and operational benefits at Fort Knox. As Fort Knox energy staff stated about the return with GSHPs, "You buy one and get four," meaning for each unit of energy you invest in you get four units coming out of the system. At Fort Knox, GSHPs have a financial payback of about 10 years. They also provide increased comfort by having more consistent temperatures, fewer

Figure C.3
Diagram of a Fort Knox Ground Source Heat Pump Project



SOURCE: Diagram courtesy of Fort Knox.

RAND MG1126-C.3

breakdowns, and almost no maintenance calls. As the garrison commander stated, “We don’t get complaints about AC and heat—that’s unheard of.”⁹ The GSHPs also reduced mold in the buildings. In fact, these advantages for occupants also help provide more support and investment in UESC projects. Fort Knox needed to upgrade HVAC systems because of frequent problems with old systems not working well, breaking down, etc. Occupants were complaining. When people saw how much more comfortable and reliable the heating and cooling were in the buildings with GSHPs, they started wanting these system in their own buildings. Since other methods of funding could take months or more, the UESC was the natural choice for these HVAC upgrades to GSHPs.

Expertise and experience were key to Fort Knox’s success with GSHPs. With its utility partner and the UESC mechanism, it developed the infrastructure to develop and support GSHPs. The utility partner, Nolin RECC, helped ensure good contracting support to design, install, and maintain the GSHPs. Proper sizing, installation, and maintenance of the systems are also important. If you oversize a GSHP system, you waste money by paying more than you need, and if you undersize it, it does not work

⁹ Comment by Garrison Commander Colonel Mark Needham; see “A Hero Behind the Scenes,” *NOLIN News: Kentucky Living*, Elizabethtown, Kentucky, December 2006.

as well, with insufficient heating and cooling. Fort Knox designs these systems well, so they are sized appropriately and are not wasting money. The coefficient of performance (COP) for GSHP systems is about 4; this means that for every one unit of energy used to power the system (e.g., one Btu of electricity consumed), the GSHP provides about 4 units of thermal space conditioning (i.e., approximately 4 Btu of heating or cooling).¹⁰ They use 500-foot deep wells in their systems instead of the more standard 250-foot wells because of cost-efficiency reasons. Once you are drilling the hole, it does not add much cost to make it deeper, and it is better to get more time underground for heat exchange. Figure C.4 shows the rig being used to drill the 500-foot well holes for a GSHP system at Fort Knox.

Figure C.4
Drill Rig Being Used to Dig GSHP Wells at
Fort Knox



SOURCE: Photo by Beth Lachman.

RAND MG1126-C.4

¹⁰ The COP values for GSHP systems range from 3.5 to 6. Compare this with the COP for a typical electric resistance heater, which is around one (i.e., it requires one unit of electricity to generate one unit of useful heat). GSHPs are generally described in terms of COP, not “efficiency”; thermodynamic efficiency is generally used to describe, for example, an internal combustion engine or another closed system, but in this case, because the GSHP makes use of thermal energy obtained from a heat source external to the system, namely the earth, this would imply an efficiency of greater than one from the GSHP system perspective.

Fort Knox also learned from its mistakes to improve the installation and operation of GSHPs. For example, on one of the first GSHPs, where the well system was under nearby ground, there were had settling and depression problems in the soil. The soil filling procedures were adjusted accordingly, and this has not happened again. Fort Knox has also learned some important things based on its unique geological situation to improve its GSHPs. A nongrouted well system actually works better than the standard grouted system due to specific properties and quality of the soil, including moisture content. This was learned through comparison of two GSHP systems, one built for a six-building barracks on a well without grout and the other for a six-building barracks on a well with grout. System performance was measured and compared between the two, and the soil proved to be a better conductor than the grout.

These examples illustrate how Fort Knox has spent the time and developed the technical expertise to have effective and efficiently operating GSHPs.

Because of the success with implementing GSHPs through UESCs and having the infrastructure to design, install, and operate them, Fort Knox also started to implement GSHPs in new construction through MILCON projects, through ECIPs, and it has had tenants and others fund GSHPs with their own money. Fort Knox has found that it costs less to install GSHPs when constructing new buildings than to add and pay more for them later. Fort Knox also demonstrated that new construction sites can be built without any natural gas for heating and cooling when using a GSHP. Therefore, Fort Knox tries to have new construction include GSHPs through MILCON funding. The new dining facility and hotel both had GSHPs installed as they were being built. It has helped having the support of the post's master planning staff and the fact that Fort Knox has put a "preference" for GSHPs in its RFPs for MILCOM projects. Unfortunately, this cannot be made a requirement. However, having a preference means contractors more often put it in their bids, and sometimes Fort Knox can get them installed this way. However, since putting a GSHP in the scope of work costs more than without it, financial considerations sometimes kill the ability to get a GSHP system installed during construction.

Figure C.5 shows the holes being dug and piping that is used for moving the heat transfer fluid in a GSHP system at Fort Knox on a new construction project.

Fort Knox has also been successful at persuading tenants to install GSHPs in their buildings on Fort Knox, both with and without UESCs. These tenants, such as the Air Force, have used their own money to install GSHPs.

Even the Fort Knox Residential Communities Initiative (RCI) contractor has been installing some GSHPs in military family housing. All nonbarracks Fort Knox on-post housing was privatized with ACTUS LEND LEASE, and thus Knox Hills LLC was formed. Knox Hills LLC owns, operates, and maintains all on-post family housing. It has installed GSHPs in some of the 800 new homes it has been building as military family housing because of the long-term financial advantages. This example

Figure C.5
GSHP System Being Installed at Fort Knox



SOURCE: Photo by Beth Lachman.

RAND MG1126-C.5

shows how successful implementation of this renewable technology has encouraged use by private interests on post.

EMCS

Fort Knox has developed and implemented an efficient and effective post-wide EMCS, mostly through the UESC process. It is using the Trane Tracer Summit System for its EMCS. Again, success came through working with the utility partner and good contractors to develop an efficient system, including effective operations and maintenance, and by starting with some pilot projects, demonstrating success and then slowly building on it. By February 2007 Fort Knox had 93 buildings within the system, and by August 2008 it was 246 buildings, or about 8 million square feet of space. In fact, in August 2008, this was the biggest Trane Tracer System in the world.

There is a special building on Fort Knox that is the headquarters for this EMCS system. Nolin RECC and Trane staff are located on site at this location. Two Trane systems automation staff members run and monitor the EMCS system in this building. With this system they can check the temperature and equipment status of individual buildings, rooms, and energy equipment. There are views of floor plans, individual rooms, boiler flow diagrams, building chiller diagrams, and mechanical rooms. These views include detailed statistics on relevant information such as temperature, humid-

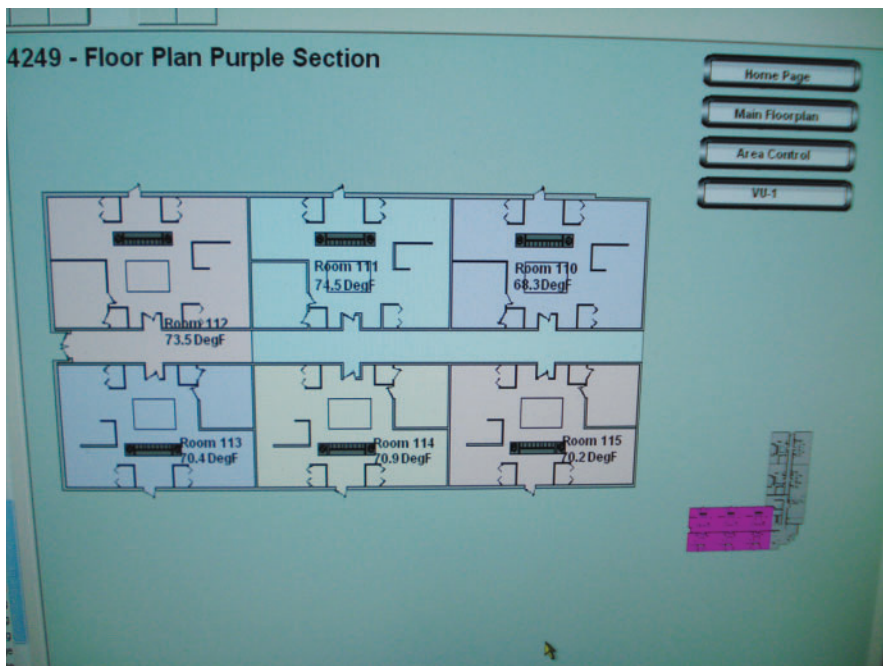
ity level, flow levels, and pressures. For an example, see Figure C.6, which shows the EMCS room temperature monitoring system for part of the Fort Knox Child Development Center (CDC). The system also includes automated controls to adjust building temperatures based on time of day and year. Automated occupancy sensors in certain buildings and rooms add to the energy efficiency of the overall system. At the new Garden Hotel, the rooms go to sleep if no one is in them, i.e., lights go off and the temperature changes.

Now every new structure that is built at Fort Knox must be connected to this EMCS system. This system is wireless; the installation information technology staff did not want to have it hooked up to the Internet because of security concerns.

Disney Barracks Area

Constructed in the 1960s, the Fort Knox Disney Barracks Area consists of 38 buildings with more than 800,000 square feet. After 40 years, the buildings were still heated by the original centralized hot water system and cooled by decentralized cooling equipment of different ages. None of the complex was on an automated system that efficiently controlled the buildings, and many buildings had poor ventilation that caused air quality problems. These old, inefficient systems used 39 percent more energy than needed. In FY05, Fort Knox used a UESC to replace 70 percent of the existing heat-

Figure C.6
EMCS Temperature Monitoring System for Fort Knox CDC



ing and cooling systems with GSHPs and to update the barracks with new ventilation systems to improve air quality. All the buildings were integrated into a wireless control system. “The project saved more than 102 billion Btu of natural gas, equating to overall savings of 70 percent and more than \$807,000 in FY 2005.”¹¹

Hospital Boiler-Chiller Replacement Project

Fort Knox energy staff used a UESC in partnership with Nolin RECC and Trane to install a \$4.8 million boiler-chiller replacement at Fort Knox’s Ireland Army Hospital in 2001. Annual energy cost savings from this delivery order were estimated to be \$1,004,011, and annual energy savings were estimated to be 131,756 MBtu. Project payback was less than five years.¹²

This central chilled water/steam plant was built in building 860 next to the hospital. It contains four 9 MBtu/hr Cleaver Brook high-pressure steam boilers with dual-fuel burners. They use natural gas as the primary fuel and fuel oil only when economics make it desirable to switch fuels. Two boilers operate all year to provide steam and hot water to the hospital, while the other two boilers are on standby. The plant also includes three high-efficiency 800-ton Trane centrifugal chillers. The chilled water system has three primary pumps and two secondary system pumps.¹³ Figure C.7 shows a photo of the hospital’s chilled water system with the green chilled water pipes.

This hospital is a MEDCOM facility. Since MEDCOM pays the utility bills for this facility, it has to pay its UESC payments. However, MEDCOM was willing to invest its money in this project to upgrade the system and because of the energy savings from it. In addition, the energy program staff are motivated to help MEDCOM because the hospital’s energy consumption statistics count in the overall Fort Knox energy usage statistics even though it is not an IMCOM building. This new boiler-chiller system also saves MEDCOM on maintenance costs. MEDCOM pays \$85,000 per year for maintenance, which is contracted out to Trane, where the old system required a maintenance staff of five government employees. This new system also provides safety and environmental benefits because the old system had four 25,000-gallon fuel oil tanks as backup; this new system requires one 12,000-gallon fuel oil tank.

The system’s operations are also closely monitored through the EMCS. Figure C.8 shows an EMCS display of the hospital chiller system.

¹¹ FEMP, “2006 Federal Energy and Water Management Award Winners,” November 19, 2006.

¹² FEMP, “Financing Mechanisms, Case Study—Fort Knox Strikes Energy-Savings Gold in Partnership with Utility,” July 2002.

¹³ For more information on this hospital boiler-chiller system, see Fort Knox, “Long-Range Energy Management Plan: Fort Knox, Kentucky,” March 28, 2005, pp. 44–45.

Figure C.7
Fort Knox's Hospital Chilled Water System



SOURCE: Photo by Beth Lachman.

RAND MG1126-C.7

Natural Gas Extraction Project

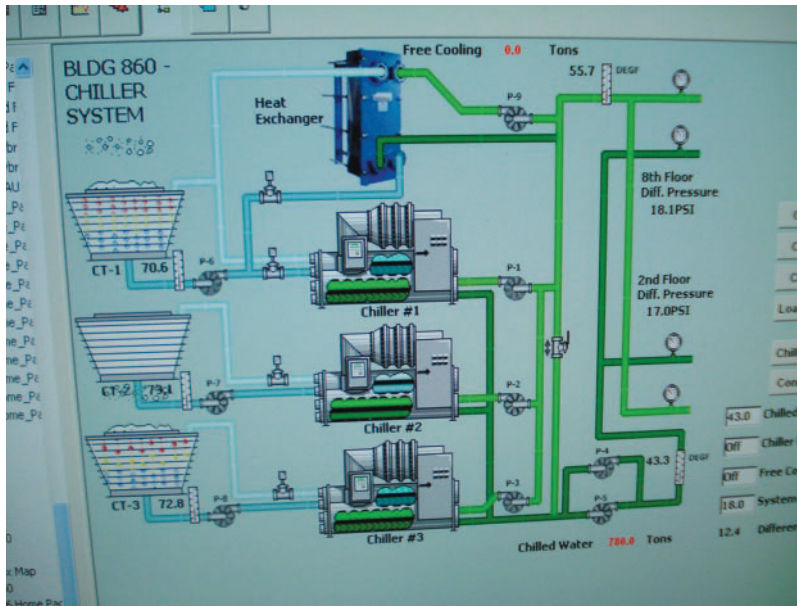
Fort Knox has been working to implement a UESC for Devonian Shale natural gas extraction, an unconventional resource that could potentially meet Fort Knox's natural gas needs. Nolin RECC awarded a contract to Trico for this project in August 2007. By August 2008, two test wells had been drilled on the post. Fort Knox was able to make the first purchase of natural gas from its own test well in January 2009.¹⁴ As of November 2010, about 10 wells were in production.

At the time of our study, one well was estimated to be able to provide 100–160 Mcf/day. Fort Knox's summer natural gas demand is 13,000–16,000 Mcf/month, or about 450 Mcf/day. This means that about four wells could meet summer demand for all of Fort Knox. Fort Knox's cost for the natural gas is 86 percent of market rate, with no additional transport costs, and therefore it would expect to save about 33–36 percent overall. In theory, Fort Knox could use the excess natural gas to make electricity and could then "go off grid" entirely. Initially, Fort Knox expected the development would supply 25 percent of the natural gas for the installation.¹⁵

¹⁴ This first purchase was made substantially below the prevailing market price for natural gas at that time.

¹⁵ As of April 2011, about 15 wells were producing (metered) gas, offsetting the need for approximately one-third of the installation's natural gas to be obtained from the wider pipeline.

Figure C.8
EMCS Display for Fort Knox Hospital Chiller System



SOURCE: Photo by Beth Lachman.

RAND MG1126-C.8

Legal, contracting, and environmental impact issues delayed this project for three years since the initial company contact. Fort Knox has completed an environmental assessment for the project, but it took a long time to go through the official environmental approval process. One part of this delay was installation legal and environmental concerns, which took a long time to address and process so that the project could be approved.

Lighting Projects

Many UESC projects include lighting changes because lighting is a “low-hanging fruit” change that often helps bring down the payback period. Fort Knox has been transitioning its lighting from 1,000W incandescent bulbs to high-intensity discharge lights (HIDs) and then to T8s (tube-shaped fluorescent lamps, 30–32W).¹⁶ Originally, Fort Knox switched to HIDs for increased efficiency (relative to both incandescent and fluorescent), but they are now being removed due to the delay in startup time, their need to cool off before they can be turned back on, and their inability to interface well with sensors and occupancy lighting strategies. Now, Fort Knox uses primarily

¹⁶ The T8s are often found in a fixture in sets of 4, consuming around 128W, in office applications. Other times they are in sets of 6, for example, in high-bay applications.

T8s with electronic ballasts, some from Sylvania/Phillips. Fort Knox has standardized three products: four-foot T8s, two-foot T8s, and compact fluorescent lights with “non-snap-back” interfaces. T8s are used for high-bay buildings.

Fort Knox now also has a standard for using occupancy sensors with the lights. If no one is moving in the room, the lights automatically go off. Now the energy savings just happens, ideally without anyone noticing and without interfering with anyone’s job.

Induction lights¹⁷ and light-emitting diodes (LEDs) are now being used for street lights. Some have “occupancy” sensors, are “instant-on,” and supposedly have lifetimes of 100,000 hours.

Other Energy Projects

In this section we briefly overview some energy projects that Fort Knox did mostly without UESCs. There are two main types: ECIP and renewable energy projects.

ECIP

Many ECIPs at Fort Knox have leveraged off of Fort Knox’s UESC experience. For example, Fort Knox has had six ECIPs that involved installing GSHPs because of the success of GSHPs in its UESCs. Fort Knox had a FY09 project funded for \$3,500,000 to help install a barracks GSHP system and another funded for \$1,200,000 to help install a GSHP system for domestic hot water along with exit lighting. Similarly, in FY07, Fort Knox received \$2,550,000 in ECIP funding to help convert a barracks to a GSHP system.

As of August 2008, Fort Knox has had 12 ECIP projects. Other ECIP projects had focused on renewable energy projects, such as photovoltaic and solar thermal projects that could not be funded by UESCs because of the 10-year payback period limitation.

Other Renewable Energy Projects

Besides GSHPs, Fort Knox has implemented some other small renewable energy projects. It is difficult for it to financially invest in many renewable energy projects because it has low-cost energy and does not have state incentives for renewable energy. Fort Knox has more solar resources than New Jersey, but solar investments are cheaper in New Jersey because of the state incentives. However, Fort Knox has installed some small solar projects using UESCs. As of summer 2008, one small 2-kW solar photovoltaic array for electricity generation was installed, as was one solar thermal system

¹⁷ These are electrode-less lamps with high lifetimes not limited by filament life.

for domestic hot water heating, providing hot water to the post fire station. These solar systems have to be maintained for 10 years by the solar contractor.

Fort Knox energy staff is also thinking and planning ahead for more solar projects. Some new structures, such as pavilions, are being built so that they are oriented to handle solar panels, so that in the future photovoltaic panels for solar lighting systems could be installed on them.

Fort Knox also installed one small 50-foot-high wind turbine in 2008. This renewable energy project was combined with some other short-payback projects in a UESC project to be able to fund it given the 10-year payback restriction with the UESC. Before proceeding with this project, the energy staff checked with operations staff to make sure there were no mission impacts from the wind turbine.

Fort Lewis Case Study

This appendix provides an overview of how Fort Lewis has been collaborating with its utilities. Since we visited Fort Lewis in September 2008, when energy staff had recently developed and signed a large-scale UESC deal, it focuses on this UESC development process. We begin by providing an overview of Fort Lewis and its sustainability program, since Fort Lewis's energy program has leveraged off its strong sustainability program. Then we provide an overview of Fort Lewis's energy program, including its relationships with its utilities, and then describe its UESC process. We also provide a brief overview of some of this post's other energy activities. Lastly, we briefly summarize some of McChord Air Force Base's energy activities and UESC-like process, since it became a joint base with Fort Lewis in October 2010. Since this appendix is describing these two installations' activities prior to that time, we still refer to them as Fort Lewis and McChord rather than the current name of Joint Base Lewis-McChord.

Overview of Fort Lewis

Fort Lewis is located in Washington State on the Puget Sound and south of Tacoma. Fort Lewis is part of the U.S. Army Forces Command and is the home of I Corps. Fort Lewis has many close-in training areas, including 115 live fire ranges. Additional training space is available at the Yakima Training Center in eastern Washington, including maneuver areas and additional live fire ranges. Fort Lewis serves more than 25,000 soldiers, many more family members and retirees; it covers more than 86,000 acres, with an additional 324,000 acres at Yakima Training Center. Several thousand structures make up the facilities at Fort Lewis.¹ In 2009 there were 17.3 million square feet of buildings on post, and present BRAC plans will increase this by 5.5 million square feet to 22.5 million square feet of buildings.

Fort Lewis and neighboring McChord Air Force Base are among 26 installations combining into 12 joint bases by the year 2011. They actually became "Joint Base

¹ U.S. Army Installation Management Command Western Region, "Public Works Joint Base Lewis-McChord, WA," last updated February 2, 2010.

Lewis-McChord” in the second phase of joint basing in October 2010. Joint basing consolidates two or more military installations into one base. The combined installations are of different Services and either share a common boundary or are close to each other. The Service of one of the original installations becomes the manager for most installation support. For Joint Base Lewis-McChord it is the Army and, therefore, Fort Lewis. The motivation for joint basing is to achieve efficiencies and support warfighting missions using common installation support functions.² Because of the merger of installation support, the two installations’ energy programs become one program run by the Army, which will impact daily operations as well as potentially affect existing contracts, such as UESCs, held individually by the two installations. As such, we follow our description of Fort Lewis in this appendix with a brief overview of McChord AFB’s energy activities.

Fort Lewis has another important activity that makes it different from some other installations; it has a strong and active sustainability program. Below we briefly describe this sustainability program because of its important synergies with Fort Lewis’s energy program. Then we describe the energy program itself.

Overview of Fort Lewis’s Sustainability Program

Like Fort Carson, Fort Lewis is a leading installation in the Army with respect to sustainability. Energy concerns are an integral part of the post’s sustainability program. Many of the important recent energy projects at Fort Lewis have been part of its sustainability program. The energy program has benefited from the sustainability program and vice versa.

Fort Lewis’s sustainability program began in 2000 within the environmental program. In February 2002, Fort Lewis hosted an installation sustainability workshop. Its purpose was to bring together stakeholders from environmental regulatory agencies, the Army, the community, and the installation to build a consensus on Fort Lewis’ 25-year sustainability goals. Initially, Fort Lewis developed a set of 12 goals and created 5 teams to develop and begin implementing projects that work toward those goals. Table D.1 shows Fort Lewis’s goals and teams as of 2007.

As the table shows, renewable energy and energy improvements in buildings through LEED were a main focus of the sustainability program. In addition, air emission and transportation concerns have helped spur energy-related activities and successes for air quality and energy. Air quality attainment is an issue for the region in general and the installation in particular. While Fort Lewis has successfully dealt with

² Joint Base Lewis-McChord, “Lewis-McChord Joint Basing,” last updated February 19, 2010.

Table D.1
Fort Lewis Sustainability Teams and Goals in 2007

Sustainability Teams	Sustainability Goals
Air Quality	1. Reduce traffic congestion and air emissions by 85% by 2025
	2. Reduce air pollutants from training without a reduction in training activity
	3. Reduce stationary source air emissions by 85% by 2025
Energy/Infrastructure	4. Sustain all activities on post using renewable energy sources and generate all electricity on post by 2025
	5. All facilities adhere to the LEED Platinum standard for sustainable facilities by 2025
Products and Material Management	6. Cycle all material use to achieve zero net waste by 2025
Sustainable Training Lands	7. Attain healthy, resilient Fort Lewis and regional lands that support training, ecosystem, cultural and economic values by 2025
	8. Recover all listed and candidate federal species in South Puget Sound Region
Water Resources	9. Zero discharge of wastewaters to Puget Sound by 2025
	10. Reduce Fort Lewis potable water consumption by 75% by 2025
	11. Fort Lewis contributes no pollutants to groundwater and has remediated all contaminated groundwater by 2025
	12. Develop an effective regional aquifer and watershed management program by 2012—completed

its air permitting Title V requirements,³ air quality is still problematic, and there are serious regional congestion issues. An example of success in helping to address such air quality concerns is Fort Lewis's efforts at converting boilers to cleaner-burning fuel oils and by switching to low volatile organic compounds in painting operations, which has contributed to a significant decrease in air emissions.⁴ These activities helped Fort Lewis comply with the Clean Air Act Amendments, and the first one—the boiler conversions—also helped to increase energy efficiency at the post.

Fort Lewis is also addressing transportation issues related to air quality. For example, Fort Lewis reduced traffic-related air emissions during 2005–2006 by increasing the percentage of alternate fuel/dual fuel vehicles in its GSA fleet to 40 percent.⁵

By 2008, Fort Lewis had restructured its sustainability program based on a five-year review of its ISP in 2007. Now it has eight goals and six teams, where infrastructure is now its own team, entitled “sustainable communities.” The latest teams and

³ Title V of the Clean Air Act requires that Fort Lewis obtain operating permits. These are “legally-enforceable documents designed to improve compliance by clarifying what facilities (sources) must do to control air pollution”; they are issued to all “major” sources of pollution. See <http://www.epa.gov/air/oaqps/permits/>.

⁴ Fort Lewis, “Sustainable Fort Lewis: 2005–2006 Annual Report,” Washington, 2006.

⁵ Fort Lewis, “Sustainable Fort Lewis: 2005–2006 Annual Report,” Washington, 2006.

goals are shown in Table D.2. Energy is now a separate team with a broad focus on energy conservation, efficiency, and investment in renewable energy sources. A main part of the energy team’s sustainability work has focused on developing a large UESC.

There are 11 members of the sustainability group at Fort Lewis, including pollution prevention staff, with four “core” sustainability staff, including the sustainability coordinator. Other staff includes the sustainability outreach coordinator, the LEED contact, and the sustainability energy team leader, who is from the energy program.

Both energy and sustainability programs have benefited from support from other installation staff and leadership, including strong support from two of the last three garrison commanders. Recent directors of the DPW have all been supportive, and Fort Lewis’s environmental lawyers and contracts attorneys have been important to recent successes.

Because of Fort Lewis’s history in sustainability, the energy program and its staff coordinate and interact with the sustainability program staff regularly, and there is overlap in duties and interest. Also, the sustainability program has given additional visibility to energy efforts, and many of the core goals of sustainability are now focused on energy. On the other hand, the energy program also has its own responsibilities and activities that do not directly fall under sustainability.

Table D.2
Fort Lewis Sustainability Teams and Goals in 2008

Sustainability Teams	Sustainability Goals
Air Quality	1. Reduce installation source and nontactical motor vehicle air emissions 85% by 2025
Energy	2. Reduce total energy consumption by 30% by 2015
	3. Sustain all activities on post using renewable energy sources by 2025 ^a
Sustainable Community	4. Create sustainable neighborhoods for a livable Fort Lewis community that enhances the Puget Sound Region
Products and Material	5. Cycle all material use to achieve zero new waste by 2025
Sustainable Training Lands	6. Maintain the ability of Fort Lewis to meet its current and future military missions without compromising the integrity of natural and cultural resources, both on the installation and regionally
	7. Recover all listed and candidate federal species in the South Puget Sound Region
Water Resources	8. Treat all wastewaters to Class A reclaim standards by 2025 to conserve water resources and improve Puget Sound water quality

NOTE: For more information, see Joint Base Lewis-McChord, “Sustainable Joint Base Lewis-McChord, WA: Sustainable Goals,” updated February 2, 2009.

^a Originally, this goal included the statement “and generate all electricity on post by 2025,” and this was still on the post’s website. However, this last part was removed to allow more flexibility in meeting the renewable energy goal. For example, the post wanted to have the option of purchasing renewable energy.

Overview of Fort Lewis's Energy Program

Fort Lewis has an active energy conservation and management program partly because it is an important component of its sustainability activities. Therefore, as noted, many energy projects since 2000 have been implemented with the help and momentum of the sustainability program.

One of Fort Lewis's main energy focuses has been through LEED implementation in buildings. LEED is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. It is an industry building standard developed by the U.S. Green Building Council, which also provides a certification process for LEED-rated buildings. Fort Lewis has been implementing LEED and other energy efficiency projects in new construction and existing buildings. For example, LEED-accredited professionals with the Seattle District of the USACE have integrated themselves into the construction process for the Fort Lewis Whole Barracks Renewal (WBR) program⁶ to continuously improve implementation of sustainability features. By implementing LEED, the WBR program saved 5 percent of energy usage relative to traditional construction in FY04, and the FY06 WBR was projected to achieve more than 30 percent savings.⁷

Other sustainability program-based energy projects at Fort Lewis have included designing and installing a Solar Wall for a logistics warehouse as a market demonstration project (see Figure D.1); implementing energy conservation initiatives, including direct digital controls and the use of high-efficiency condensing boilers throughout new construction; and purchasing 10 percent of power from green sources in 2007 in the form of renewable energy certificates (RECs). By spring 2008, Fort Lewis was purchasing 21 percent of its power from green sources.

Many of these successes have occurred because of Fort Lewis's active sustainability initiatives. However, Fort Lewis energy program staff have the lead on the sustainability energy team, so there is a close working relationship between the two programs and it is difficult to separate out their activities. Actually, such integration is expected, since sustainability is about integrating sustainability principles into other functions and vice versa. In addition, the energy program at Fort Lewis is focused on facility energy use and is not directly involved in activities such as transportation and fuels projects, nor is it technically responsible for LEED activities, both of which, as noted, are done under the auspices of the sustainability program.

In the past, the energy program also has implemented an ESPC, which was started in 2001–2002. This ESPC implemented the installation's first direct digital

⁶ The WBR program is slated to build several new barracks at Fort Lewis.

⁷ Fort Lewis, "Sustainable Fort Lewis: 2005–2006 Annual Report," Fort Lewis, Washington, 2006.

Figure D.1
Fort Lewis SolarWall on a Logistics Warehouse



SOURCE: Photo by Beth Lachman.

RAND MG1126-D.1

control (DDC) system.⁸ The DDC system was to be used to improve building energy efficiency, such as changing the temperature in buildings to save energy when they are not occupied.

Fort Lewis was a 2005 recipient of DOE's "Federal Energy and Water Management Award" in the category of "Energy Efficiency/Energy Program Management Awards to Organizations."⁹ The award cited development and implementation of energy projects in FY04 that resulted in the reduction of energy use by 19 percent below the 1985 baseline. Also noted were Fort Lewis's ESPC project and its "comprehensive sustainability program" that in FY04 included the installation's first LEED facilities, increased use of alternative fueled vehicles, and the purchase of 12 gigawatt-hours of green power. "Projects implemented in FY 2004 saved \$500,000 and almost 50 billion Btu."¹⁰

⁸ A DDC involves applying microprocessor technology to building environmental controls and is used to control heating and cooling functions with computer software based on the user's desired conditions, thereby achieving greater energy efficiency.

⁹ FEMP, "Federal Energy and Water Management Awards," U.S. DOE.

¹⁰ FEMP, "Federal Energy and Water Management Awards," U.S. DOE.

The installation had also previously received a FEMP Award in 2002 in the same category for its response to West Coast electricity reliability issues. “Fort Lewis implemented extraordinary measures both unilaterally and in partnership with the local electric utility, Tacoma Power, DOE, and the Army/Air Force Exchange Service to reduce overall electric demand. The Fort was able to implement strategic energy conservation and demand reduction measures quickly with the support of Command level interest.” Energy reduction strategies included installing refrigerated vending machines that reduced energy use, installing compact fluorescent light bulbs in family housing, developing a team to oversee the efficient use of HVAC equipment, and providing ongoing energy awareness training for soldiers. “Savings of \$587,000 and almost 80 billion Btu were achieved at Fort Lewis during FY 2001.”¹¹

More recently, Fort Lewis has developed a large-scale UESC project, which will be discussed in more detail below. Also, it is significant to note that Fort Lewis was the first federal entity to ever do a UESC in 1992, so the installation has had previous experience in using UESCs. First, we briefly describe staffing issues regarding the energy program.

How the Energy Program Is Organized and Staffed

Organizationally, Fort Lewis’s energy program moved from Master Planning to the Environmental Division in 2005. The Environmental Division has two main branches, Compliance and Forestry, and several other branches, such as Sustainability. There are approximately 60 staff members in the Environmental Division, and at least half are contractors rather than Department of the Army civilians. The energy program falls under the Compliance branch of the Environmental Division, which includes also the air, water, and remediation programs.

The energy program is officially managed by the energy manager (EM). The EM at Fort Lewis is a civilian position that had been vacant beginning in the fall of 2008 for about a year. In the absence of an EM, the head of Compliance technically serves that role. The EM at Fort Lewis wears two hats as both the air manager (as noted, air is another subdivision of the Compliance branch) and the energy program manager. In addition to the EM, other energy staff includes the energy program coordinator (EPC) and the utilities manager, as well as systems managers such as HVAC, mechanical, and electrical technicians. The energy program coordinator for Fort Lewis, like the EM, reports directly to the head of the Compliance branch.

Historically, when the energy program was under Master Planning, Fort Lewis had a stable energy manager for about eight years. This EM was a contractor via Washington State University who was very active, but who left when this contracting mechanism was no longer available. Since then, there have been many turnovers in the EM position. There were also a number of energy program coordinators in the past who

¹¹ FEMP, “Federal Energy and Water Management Awards,” U.S. DOE.

were managed under Master Planning. Staff issues have contributed to less-active periods for the energy program, though the sustainability program has helped keep energy activities going when energy program staff shortages have occurred.

The current energy program coordinator for Fort Lewis is a contractor who has been in the position since 2007. Prior to that, he was the BRAC environmental coordinator for Fort Lewis. The energy program coordinator position occupies 100 percent of his time. A big part of the energy program coordinator job is coordination and facilitation of communication. The energy program coordinator is not officially authorized to manage the energy program, but rather provides recommendations to the sustainability staff, the utilities manager, and others working in and with the energy program. However, in practice, he functions much like an energy manager, especially when the position is not filled. The energy program coordinator has responsibility for DPW's energy management systems and is also the team leader for the energy team within the sustainability program. The energy program's utilities manager at Fort Lewis has responsibility for contracting with the utilities and is active in the UESC process.

Fort Lewis's Relationship with Its Utilities

Fort Lewis has a good working relationship with its utilities. It purchases natural gas from Puget Sound Energy (PSE) and electricity from Tacoma Public Utilities/Tacoma Power (TPU).¹² TPU in turn relies on the Bonneville Power Administration (BPA) for part of its electricity supply. This indirect commodity purchase fulfills the requirement for BPA to enter into a UESC agreement with Fort Lewis, which it has recently done. Fort Lewis does not have to negotiate its electricity rates because in its contract it is guaranteed the same rates as comparable customers. In practice, this means it gets the same rates that neighboring McChord AFB gets.¹³

BPA is the official UESC partner for Fort Lewis. BPA has a contract with TPU. BPA is helping TPU meet conservation mandates. BPA has worked with Fort Lewis on other energy efforts prior to the UESC. For example, BPA completed a study on voltage regulation of the transformers in its substations to improve energy efficiency and a small study on customer assistance, both at its own expense.

Fort Lewis has had a number of other interactions with its utilities that illustrate the working relationships. BPA has provided free consulting for about two years (outside of the UESC agreement). BPA is also discussing with regional utilities the idea of putting Fort Lewis on a fiber SCADA system as part of a "military loop" (which includes McChord AFB). TPU and PSE host integrated regional planning meetings, to

¹² Tacoma Public Utilities actually includes Tacoma Power as well as Tacoma Water and Tacoma Rail; formerly it was Tacoma Light and Water Company, but it is also referred to as Tacoma City Light, TPL, or Tacoma Power and Light.

¹³ McChord AFB, in contrast, hires a consultant regularly to aggressively negotiate rates with TPU. Fort Lewis benefits from these efforts in its own lower rates.

which Fort Lewis has been invited and the energy program coordinator often attends. Also, TPU has, in the past, offered some financial assistance for energy conservation projects to Fort Lewis and, recently, has asked Fort Lewis for a 20-year energy-use forecast to help with TPU's planning.

The UESC Process

This section overviews the UESC experience at Fort Lewis. Because this relationship is relatively new, we detail the history of initiating the UESC and some of the issues that have come up in negotiating this arrangement. We also cover the anticipated approach to handling projects under the UESC, especially the O&M and M&V, as well as some unique issues of the financing of Fort Lewis's UESC agreement. We begin by summarizing the main features of the UESC as of fall 2008.

Fort Lewis signed a UESC with BPA in 2008 using an interagency agreement. Since TPU supplies Fort Lewis with electricity and is a BPA customer, it allows BPA to provide utility services, such as the UESC, to Fort Lewis. Fort Lewis projects that it will spend \$18 million under its new UESC, and that this will buy \$39 million in energy efficiency projects with a 3.6-year simple payback because of expected rebates totaling \$23.8 million. Cost and energy savings are expected to be \$4.3 million and 456,000 MBtu per year. The installation will essentially be receiving half of these projects for free because of the large rebates it will get for electricity savings from its energy efficiency projects. The rebates will be obtained from TPU and Puget Sound Energy (Fort Lewis's gas provider). This significant rebate opportunity is unique to installations operating in locations with state utility commission-sponsored rebates and potentially provides substantial benefit to Fort Lewis relative to installations working in other regions of the country where such rebates are not available (such as Fort Knox and Fort Campbell).

History of the UESC Agreement at Fort Lewis

BPA first approached Fort Lewis about entering into a UESC agreement in 2007. At the time, BPA was interested in exploring the UESC option and offered to provide free staff for two or three days a week, with the balance of the staff's time spent working for and at BPA. A broad interagency agreement that established the UESC guidelines and the "rules of play" between BPA and Fort Lewis was signed in August 2007. This resulted in Fort Lewis having immediate free access to a GS-14 working out of Portland from August 2007 to August 2008. This BPA staff person also enlisted the assistance of numerous technical experts as needed in areas from energy efficiency to metering, providing additional benefit to Fort Lewis.

An important part of the UESC development process was energy auditing, especially BPA's free energy auditing. BPA energy auditing at Fort Lewis started in August

2007, as did a concurrent Energy Engineering Analysis Program audit by the Army.¹⁴ The targeted buildings for the initial work under the UESC totaled about 17 million square feet, with the BPA contractor's audit sampling the targeted area by covering about 4 million square feet as well as the steam traps. The audit included various tests, such as usage tracking and data logging.

With respect to the terms of the contracting, BPA has been extremely flexible, which has allowed the Fort Lewis staff to determine their own payment scheduling. They opted to pay monthly so that it would be analogous to a utility bill, but BPA would have allowed yearly payments.

Anticipated Approach to O&M and M&V

Daily and routine operations and maintenance of UESC equipment will be performed by Fort Lewis in-house staff (e.g., staff in the mechanical branch). New equipment will have a one-year warrantee, after which time the base will assume the responsibility for maintenance in an arrangement analogous to the one now in place for the several hundred infrared (IR) heating systems currently in use, which have a specific internal contract for their repair. Since the initial work under the UESC will be "quick hit" projects, i.e., "low-hanging fruit" investments that can be implemented immediately and which will have fast payback, the maintenance is expected to be minimal and relatively straightforward. Initial investments will include an economizer on the hospital boiler and replacement of the old IR heating systems. These new systems are actually expected to be easier to maintain than the present ones, and it is expected that there will be less labor requirements due to the decreased need for repairs. The installation was short-staffed for such repair work in fall 2008.

Fort Lewis may need to have maintenance staff train for new types of equipment. The plan is to either train in-house staff or bring in external experts, as needed, with the O&M savings of the new equipment. Additionally, preventive maintenance efforts have been promised and should be possible through A-76 contracting mechanisms. For the more technically complicated projects, O&M could potentially be rolled into a UESC task order if it becomes an issue down the road.

Even though neither is responsible to the Washington Utilities and Transportation Commission, both BPA and TPU are motivated for the UESC at Fort Lewis to produce the maximum energy savings possible. Fort Lewis is a large regional energy user, and BPA is genuinely interested in making real energy efficiency savings in the face of population growth and its need to meet growing energy capacity demands. Similarly, TPU

¹⁴ The "Energy Engineering Analysis Program (EEAP), as discussed in AR 420-49, is primarily designed to assist garrisons in achieving energy reduction goals to meet EPACT 2005 mandates." It consists of a "detailed site energy survey." Army Energy Program, "EACA & EEAP."

is answerable to the renewable energy requirements in state initiative I-937.¹⁵ In both cases, the utilities have an interest in providing technical support to ensure the savings.

M&V will be performed by the BPA contractor and also by PSE and TPU. M&V is included in all delivery orders of a given task order under the UESC.

Contracting, Legal, and Technical Issues in UESC Development

Much of the delay and complication associated with the installation's UESC process has been related to a lack of education and misinformation among the various base staff that have been involved with establishing first the interagency agreement and then the first task order under the umbrella agreement.

A lack of familiarity with this type of agreement, and a lack of a clear authorization from and guidance by HQDA, initially made the contracting and legal staff leery of embarking on what they believed was a potentially illegal, expensive, long-term agreement with utilities. With ongoing outreach, education, and coordination, Fort Lewis energy staff were able to overcome this barrier and have the legal and contracts staff support the UESC process.

Financing Issues Related to State Rebates

Fort Lewis has unique financing issues associated with establishing a UESC contract in a state with utilities commission-sponsored energy efficiency rebates. As noted, while Fort Lewis's UESC agreement is with BPA, TPU will also be involved in the relationship. As negotiated in an agreement between BPA and TPU, TPU will get the conservation "credits" from Fort Lewis's energy efficiency projects to satisfy its own Washington Utilities and Transportation Commission requirements, and then BPA (and ultimately, Fort Lewis) gets the dollar amount of the rebates to invest in more energy efficiency, and possibly renewable energy, capital improvements. BPA has agreed to deal with rebate legitimization and negotiation on Fort Lewis's behalf. Using the UESC mechanisms, all rebates go to BPA, and it in turn agrees to invest in energy efficiency projects at Fort Lewis as part of the contract agreement.

While the details of handling these rebates add complications to the UESC task order agreements, the state-level incentives have clearly helped Fort Lewis advance its UESC ambitions. For example, Fort Lewis initially approached TPU over four years ago about embarking on such a relationship and was met with limited interest by the utility. However, TPU's ability to get conservation credits, as now required by the Washington Utilities and Transportation Commission, by working with Fort Lewis, recently motivated it to become involved in the UESC. TPU's interest in compliance with state-level renewable energy goals has also prompted it to explore deployment of less economical technologies at Fort Lewis, all to the installation's benefit.

¹⁵ I-937 is "Ballot Initiative 937," passed in November 2006, which requires large utilities in Washington state to have 15 percent renewable energy by 2020 and undertake all cost-effective energy efficiency measures.

UESC Projects

As of fall 2008, Fort Lewis had just negotiated the first task order in its new UESC agreement with BPA. Before giving the details of that task order, we describe the general characteristics of projects expected under this UESC and the process immediately leading up to the agreement.

General Information and Initial Thinking on UESC Projects

In terms of crafting the initial UESC interagency agreement, DoD and EEI had a skeleton UESC that Fort Lewis used as a reference. From there, the energy staff at Fort Lewis essentially made use of neighboring McChord AFB's interagency agreement with minor modifications. Individual task orders under the UESC will define the specific terms of financing, and the specific project delivery orders will then be "packed" under these task orders and will include M&V by BPA. All projects will have a simple payback of 10 years or less. To achieve this payback, different technologies are bundled, for example, large natural gas savings might offset the costs of more expensive capital equipment or metering. Energy audits will allow BPA and Fort Lewis to combine upgrade and technology costs, rebates, and energy savings into a draft task order that meets the required payback. All draft task orders will be subject to discussion and approval coordinated locally as well as with IMCOM/ACSIM. The substance of task orders will be critically dependent on current interest rates. Within this basic framework, complications and caveats may emerge in implementation of the given task orders and delivery orders. Even though BPA is an electricity generation and transmission entity, it is "fuel neutral" in its UESC task order development. As such, many of the UESC projects at Fort Lewis will aim to reduce natural gas (NG) use, and BPA estimates that 30–40 percent decreases in NG usage will be possible at Fort Lewis via UESC task orders.

A number of initial targets for preliminary projects have been identified based on largest energy use, and the energy staff noted that they would not necessarily have predicted them in advance of the auditing process. The audit revealed that several warehouses were being heated around the clock (with steam) to 78 degrees, underscoring the difficulty of identifying energy problems with a lack of general metering. The hospital is also a big energy user, consuming 20–30 percent of total electricity at Fort Lewis. However, the hospital is a separate, billable customer, with its own command. Most of the individual metering on post is for such "reimbursable customers," of which there are about 50 including privatized housing.¹⁶

¹⁶ The utilities manager signs off on the total installation energy use and billing, and then bills these other customers for their portions of the energy use.

First Task Order

The original draft task order agreement was 10 years at approximately 6.8 percent, assuming a \$5 million project, the minimum of interest to BPA. Once BPA performed the audits and crunched some numbers, BPA and Fort Lewis staff agreed on an \$18 million contract, financed over 10 years at 6.8 percent. This works out to roughly \$207K/month.¹⁷ BPA predicts an energy savings of 23 percent or more overall, including both electricity and natural gas. Estimates from totals and substation meter information can be made. Natural gas and metering is owned by PSE via privatization in 1983, so those baselines are available.

Other Energy Projects at Fort Lewis

In this section we describe some of the other ongoing energy projects at Fort Lewis. We begin by describing an ESPC project that originated in the energy program while it was still under Master Planning.

Heating and DDC ESPC Project

Fort Lewis's ESPC started in 2001 during the time of the utility privatization process. The project was a heating upgrade for about 40 existent buildings and included installation of a direct digital control (DDC) system. The contract "year zero" in which Fort Lewis began making payments was 2001, but installation ran through 2002. Johnson Controls was the ESCO, and with a 17-year term, the contract continues to be in effect today. Total monthly payments to Johnson Controls are \$45,000, with about \$8,000/month for labor and maintenance.¹⁸

The ESPC project enabled Fort Lewis to get its first DDC system, including the setup of a software system with graphical interface, which would not have been affordable in the absence of a contracting mechanism for making payments over time.

¹⁷ Compare this relative to approximate totals of vendor invoices for the installation's annual energy bills: ~\$11 million/year electric; ~\$15 million/year in natural gas; ~\$3.5 million/year in fuel oil. IMCOM pays some fraction of these bills for the reimbursable customers within Fort Lewis, and approximately \$10 million/year is recovered for the command in this way. 80 percent of these totals are for commodity, with the other 20 percent as labor and fixed costs, but they also include water and waste water treatment.

¹⁸ According to DOE's FEMP, this was an FY03 ESPC that included

zone setback controls and space heating infrastructure upgrades; new control valves for heating, steam, and domestic hot water applications; and added insulation to exposed heating and hot water distribution systems. Load assessments at six key buildings, funded by the Department of Energy, identified additional low-cost energy savings opportunities such as repairing dampers, adjusting heating schedules, and tuning boilers. The Public Works staff implemented the recommended measures, while also converting incandescent traffic lights to LED technology throughout the installation.

See FEMP, "Federal Energy and Water Management Awards," U.S. DOE.

Sustainable, Energy Efficient Housing and LEED

As described above, past efforts in LEED buildings, both in new construction and in retrofitting of existing buildings, saved 5 percent of energy usage relative to traditional construction in FY04, and more than 30 percent savings in FY06. Fort Lewis has done its own “LEED certification” in the past, but it is moving to third-party certification, which is required to achieve actual LEED status. This will likely just occur on new buildings going forward rather than being done retroactively on existing buildings. While technically a sustainability program initiative (through WBR), the energy team and program are likely to be more involved with LEED going forward as Fort Lewis works to meet EAct and EISA goals.

In support of its LEED activities and in partnership with the Northwest Energy Efficiency Council and FEMP, Fort Lewis helped organize and conduct a Building Operator Certification Training course on post in 2003. Lessons learned included appreciating the value of “more emphasis on energy conservation techniques and . . . better building commissioning and re-commissioning processes” in the design and pre-construction phase, as well as understanding the role of practices and culture on energy savings.¹⁹

Much of the LEED construction at Fort Lewis has been for barracks. One such FY05 LEED Gold project accommodates 200 Soldiers from each of 8 companies; the design is four mirror-image buildings. Technologies and materials utilized include ductless heat pumps for space conditioning; nonpotable water toilet flushing systems (using water from roof drain systems) and waterless urinals; DDC systems with full communication for all four buildings; use of natural lighting coupled to dimmable lights, with both light-level and occupancy sensors; “last man out” master switch to cut off lighting at the end of the day, coupled to a programmable timer for default shutoff; and use of wheat chaff materials for cabinets and railings. Runoff from the barracks parking lot is collected and separated into separate oil and water tanks; the water is routed to a nearby runoff pond rather than into the sewage system.

Another major effort at Fort Lewis is a new WBR modular housing project (Unaccompanied Enlisted Personnel Housing (UEPH) housing for FY07), which is to be LEED Silver Certified. It consists of 89 separate modules that total about 60,000 square feet and make use of advanced energy-saving technologies. California-based Comark is the manufacturer. Figure D.2 shows modular building construction at Fort Lewis. Fort Lewis also was the site of the DoD’s first ENERGY STAR modular construction for energy efficient housing in 2006 and 2007. The project consisted of 864

¹⁹ FEMP, “Fort Lewis Benefits from Building Operator Certification Training,” March 21, 2005, and Building Operator Certification, “Ft. Lewis Army Base, Ft. Lewis, Washington,” undated.

Figure D.2
Modular Building Construction at Fort Lewis



SOURCE: Photo by Beth Lachman.

RAND MG1126-D.2

homes built by Equity Residential as part of a 50-year housing privatization contract with the U.S. Army.²⁰

Sustainable Interiors Showroom

While not specifically an energy-focused program, the Sustainable Interiors Showroom is a project of the sustainability team that features energy-saving (and water-saving) products.

Fort Lewis has been working to get the word out on reusable and sustainable materials Army-wide. For example, at an IMCOM-hosted energy summit in the summer of 2008 (in Ridgeland, Washington), Fort Lewis staff discussed their use of reusable materials and the reusability of all materials, their Sustainable Interiors Showcase, and their composting program on post, which includes a weekly pickup program at the commissary.

²⁰ U.S. DOE, "Fort Lewis Army Base," *Building America Best Practices Series: Volume 5—Builders and Buyers Handbook for Improving New Home Efficiency, Comfort, and Durability in the Marine Climate*, February 2006.

Purchasing RECs

As noted, the ability to sustain installation activities using renewable energy has long been an objective of Fort Lewis's sustainability team. To work toward this goal, and to fulfill LEED requirements, Fort Lewis has historically made use of the purchase of renewable energy certificates (RECs), which accounted for more than 20 percent of base power use by early 2008.²¹ As such, the installation had a five-year contract with, and has been purchasing RECs from, the Western Area Power Administration (WAPA) from 2005 to 2010.

However, because the value of RECs has increased in recent years, WAPA is interested in getting more for them than Fort Lewis has been paying; WAPA and Fort Lewis recently began exploring the possibility of renegotiating with REC brokers, and discussing the impact of these renegotiations on both parties.²² Not only has Fort Lewis relied on these RECs for its LEED compliance and meeting its renewable energy goals, but WAPA has already listed these REC purchases, and the contractual implications of renegotiating are potentially complicated.

There are two different ways to view this issue. On the one hand, as an early adopter, Fort Lewis could receive some benefit or preferential rates for helping contribute to the success of RECs. On the other hand, the very success of RECs that has driven prices up may indicate that it is time for the government and the Army to move on to the next logical phase in renewable support—namely by doing their own generation through financing mechanisms like UESCs.²³ For example, Fort Lewis could continue to buy some quantity of RECs (~10,000) to satisfy LEED requirements, emphasizing purchase of local RECs if possible to reduce costs and eliminate markup from brokers. The rest of its renewable energy goals could, in theory, be met by building its own generating capacity, as discussed in the following section regarding Fort Lewis goals to go “off-grid.”

2025 Goals: Off-grid and 100 Percent Renewable Energy

The Fort Lewis sustainability team has stated a goal to “Sustain all activities on post using renewable energy sources and generate all electricity on post by 2025.”²⁴ In theory, a combination of demand reduction, purchasing of RECs, and on-site renewable energy generation would be used to meet this goal. However, there are concerns that this goal may not be realistic in practice. As such, Fort Lewis staff have begun to

²¹ One REC is 1,000 kWh, or 1 MWh, of “green” electricity.

²² Fort Lewis pays \$2.50–\$3.00/REC from WAPA, compared with the more recently negotiated \$6.00/REC that it pays to TPU.

²³ This would be done despite arguments of the relative efficiency and cost-effectiveness of purchasing RECs for the base, and in part because of both the assumed relative ease of siting on Army bases versus elsewhere and the “public good” of building renewable energy capacity.

²⁴ The wider Army also has ambitions to encourage on-site power generation and to go “off-grid.”

look into the feasibility of the goal and to examine potential limiting factors—if necessary, scaling back to a goal that can be met.

The first potentially limiting factor for supplying the base with 100 percent renewable energy is local and/or regional renewable resource availability. To address this question, PNNL was asked to do an analysis of renewable resources, and two scenarios have been examined: regional (i.e., including off-site), and on-site renewable power generation. In the first scenario, using off-site renewable energy (i.e., if going completely “off-grid” for absolute “energy security” is not the primary objective), the regional renewable resource appears to be sufficient to meet Fort Lewis’s energy needs.²⁵ Combining geothermal power, solar radiation, biomass,²⁶ municipal waste to energy, and wind availability in the region, the resource is adequate, and the economics are favorable for wind and biomass. Specifically, a wind inventory was performed for Fort Lewis, McChord AFB, and Yakima Training Center to determine the resource availability and to make recommendations for utilization of regional wind power. On the other hand, 100 percent on-site renewable energy does not look realistic for Fort Lewis. Fort Lewis is located west of the mountains, so the solar resource is marginal; there is not much wind; there are no options for expanded microhydro; and there are limited opportunities for use of biomass. These two “unconstrained” estimates of pure resource availability need to be examined in the context of (1) the impact on the mission and (2) the long-term ability of renewable energy to serve the base under expansion plans—in combination with efficiency and conservation goals—to see what is truly feasible.

The specific characteristics of a renewable energy technology may be relevant to the impact on mission. In the case of wind, potential problems are interference with flight operations and general incompatibility with training. This includes ice throw from wind turbine blades in winter months—which can impact both ground training and flight operations—in addition to needing to adjust flight patterns in general to avoid wind turbines. The counterargument to these mission-impact concerns is that, as always, the Army wants to “train as you fight,” and since in theater there may also be wind turbines and power lines, there is value in training with this infrastructure. All renewable energy can have similar potential local impacts, and since the goals of using renewable energy and being able to do installation “islanding” have both been stated, the Army needs to grapple with the mission impact versus energy goal tradeoffs. The Army also needs to consider the energy goals and the impact on mission in the context of the costs of the various renewable energy technologies.

SolarWall

Fort Lewis installed a SolarWall on a large logistics warehouse (DOL Building No. 9580) (see Figure D.1). This was a sustainability project paid for with ECIP funds,

²⁵ Importantly, this assumes the availability of and lack of siting issues for sufficient transmission.

²⁶ The biomass potential is from the wood debris from the post’s sustainable forestry program.

and no M&V was budgeted for or included in the contract. The SolarWall is a space-heating technology, and the warehouse on which it was installed at Fort Lewis has five acres under one roof. The facility is used for vehicle maintenance, and in the past the mechanics there often worked with very low air quality, especially when heating was an issue and the space was kept closed for temperature control. The need to ventilate was part of the consideration for the technology selection. A SolarWall was therefore added to the (fresh) air intake for the HVAC system.

The SolarWall system uses solar radiation (i.e., light absorbed by the material in the SolarWall itself) to generate heat. Ventilation air is then moved through small holes in the SolarWall for preheating the air prior to its passing into the HVAC system. The technology has a high return on investment and is the “lowest-cost” solar technology available today, displacing 20–50 percent of fuel heating needs by preheating air by up to 30–70° F (on sunny days).²⁷ The small holes cover the entire SolarWall and create a very high surface area for contact of the heated metal with the fresh air passing through it.²⁸

Overview of McChord Air Force Base

McChord Air Force Base is the home of the U.S. Air Force 62nd Airlift Wing, the primary unit on base, and is located immediately northeast of Fort Lewis. As described earlier, the two installations will combine into Lewis-McChord Joint Base in 2010.²⁹ McChord AFB is substantially smaller than Fort Lewis, both in terms of geographic area as well as in population, with about 15 percent the land area, namely, 6 square miles versus 16 square miles, and approximately 25 percent of the population.

Overview of McChord AFB’s Energy Program

McChord has an active energy program and has benefited from a proactive energy staff. In fall 2008, the energy manager had been involved in the area of energy at McChord AFB for over 15 years, and had been at the base for even longer, but was nearing retirement.

McChord established a UESC-like agreement with BPA under which it had executed its first task order in fall 2008 and was in the process of carrying out the second. Even before the UESC work with BPA, McChord had made substantial energy savings relative to its 1985 baseline. In 1995, activities of its energy program had resulted in

²⁷ For more information on the technology, see SolarWall.com, “Solar Air Heating and Ventilation with Solar-Wall Systems.”

²⁸ Fort Drum and Fort Carson have also utilized this technology.

²⁹ Joint Base Lewis-McChord, “About Us,” Joint Base Lewis-McChord, Washington, updated February 19, 2010.

about 18 percent less energy use overall relative to 1985. By 2005 and 2006, usage was about 28 percent less compared to this baseline. McChord achieved such savings even with a large growth in air conditioning use on the base, which, unlike at Fort Lewis, is allowed for personal cooling. In 1985, McChord had 750 tons of air conditioning; today it has 8,000 tons of air conditioning, not including window units. All savings estimates are based on master meter data.

McChord's Relationship with Its Utilities

McChord AFB, like Fort Lewis, purchases its natural gas and electricity from PSE and TPU, respectively. However, its relationship with TPU is very different from the one that Fort Lewis has. Because McChord has a “negotiation clause” in its utility contract with TPU, it has to actively work to maintain the contract terms and, consequently, to keep its electricity rates. As a result, McChord has had three lawsuits with TPU since 1988, all related to rates.

However, since the passage of state initiative I-937, TPU has begun looking for a financial and contracting vehicle to accommodate McChord in its energy efficiency efforts. PSE and McChord AFB have a relatively good relationship, and PSE has also recently offered energy efficiency assistance and incentives to McChord. For example, it is providing an \$800,000 grant for the installation of a “Steam Eye,” a steam-trap monitoring system that helps identify leaks and thereby reduces energy losses in the system.

McChord has a “quasi-UESC” with BPA. As with Fort Lewis, while BPA is not a direct commodity provider for the base, it is a major electricity generator and the energy clearinghouse for the Pacific Northwest region and therefore indirectly supplies electricity to McChord through TPU. The approximately 50 percent of TPU's electricity that comes from BPA allows McChord to enter into a UESC with BPA.

In addition to this UESC-like contract, BPA helped to broker the deal with PSE for the Steam Eye upgrade. BPA acted as the middleman for McChord to get this utility-offered incentive, including investigating the opportunity and making sure that McChord received the money. BPA and its architecture and engineering (A&E) firm actually performed the audit (via the UESC), then gave the information to PSE and convinced them of the savings that allowed McChord to qualify. PSE itself has limited resources and so could not do the audits itself to provide the “substantial” documentation of the savings needed in advance.

BPA also provided funding for the registration fee for the Seattle Annual Energy Conference for McChord staff and offered to finance McChord's energy audits in advance of its UESC, although McChord opted to pay for the audits itself.

The Quasi-UESC Process and Projects

This section describes the quasi-UESC agreement that McChord has with BPA as well as some of the projects enabled by this agreement under its first task order. The agreement is a “quasi-UESC” because while BPA provides the energy capital equipment and services, it does not provide the financing for the agreement; rather, BPA is the broker for the arrangement, and McChord makes payment directly to a third-party lender and not to BPA.

One advantage of having this contract in place is that “year-end” money that becomes available from DoD can often be received virtually overnight and committed immediately to a project with BPA. For example, at the end of September 2008, McChord actually had a delivery order written up with an estimate and ready to go, and a subcontract on the UESC agreement was easy to put together when the funds became available.

History of the UESC Agreement at McChord AFB

McChord AFB energy staff started to work toward a UESC agreement as early as 1999. However, the quasi-UESC agreement was not in place until 2004. In the interim, there were many obstacles, from resistance by the base contracting officer, to delays in approval at the base and headquarters levels. Many staff, from the contracting officer to the wing commander, had to approve it before it could happen.

McChord’s umbrella UESC agreement with BPA is for 25 years, against which it is able to write the individual task orders; within these task orders there are multiple delivery orders. The UESC process began in 2003; in 2004, the financing was obtained. McChord was initially able to borrow \$6 million from lender Hannah-Armstrong for the quasi-UESC arrangement that BPA brokered. As of fall 2008, one task order had been completed, and the second had been drafted and reviewed by installation headquarters staff and was awaiting approval for funding by senior leadership.

McChord AFB’s Approach to O&M and M&V

McChord staff perform their own O&M on UESC equipment. They included the O&M savings from lower-maintenance new equipment as part of the task order to obtain the net project costs and calculate the payback period.

As a result of Executive Order 13423 and an Air Force initiative to respond to it, electric metering has been done on the base. PSE metered for natural gas use in the 1980s during the move to privatized utilities; PSE therefore owns these meters.

According to the terms of their UESC agreement, M&V is performed by BPA. The database being used was designed to work with the base’s EMCS system, and it generates reports on energy use in terms of, for example, MBtu/KSF. The monitoring/EMCS system selection was made by BPA. BPA has someone with expertise in this

area on staff that tested three systems at McChord and made a selection; BPA staff continues to help maintain and operate the system as part of their M&V. The operator of the EMCS system is a subcontractor with BPA and is paid quarterly by BPA as part of the UESC.

UESC Projects

McChord AFB's UESC has directly and indirectly (through other funding mechanisms) enabled it to deploy a number of technologies and make a number of upgrades and improvements to achieve significant energy savings in the last four to five years. These have included lighting upgrades, including T5/T8 high-bay and low-bay retrofits; steam trap retrofits and repairs, and steam metering (which complement the Steam Eye monitoring system); HVAC repairs; installation of new controls to control processes and increase efficiency in a paint hangar that needs to be maintained at 80°F (Building 1160); and increased HVAC auditing in many buildings. Additionally, the EMCS upgrade and metering efforts with BPA were done under the first UESC task order. McChord was able to obtain an additional \$1.2 million in funding for this project (under task order 1, delivery order 15), but ultimately it was funded directly by Air Mobility Command and Headquarters in response to Executive Order 13423 metering requirements. So far, McChord has not looked seriously into renewable energy projects due to its sense of a lack of real feasibility; renewable energy use will likely be constrained both by resources in the region and impact on mission.

McChord AFB's energy staff rely heavily on BPA to help implement the energy efficiency projects under the UESC. McChord's energy manager would not have the time to handle all of the details that BPA takes care of under the UESC. Under this agreement, BPA deals with contractors and subcontractors, generates and circulates bids for projects, and takes care of coordination and installation of equipment. The UESC enables energy efficiency projects that would financially and logistically not be possible without the arrangement.

Bibliography

Amin, Massoud, and John Stringer, "The Electric Power Grid: Today and Tomorrow," *MRS Bulletin*, Vol. 33, April 2008. As of July 2011:

<http://www.physics.ohio-state.edu/~wilkins/energy/Resources/survey/harnessing-mtl-energy-2008Apr/elgrid-2art.pdf>

"Approaches for the Application of Advanced Meters and Metering Systems at Federal Facilities through Alternately Financed Contracts," U.S. DOE, January 2005. Available at:
<http://ateam.lbl.gov/mv/>

Army Energy Program, "Alternative Financing–ESPC," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/funding/esp.asp>

Army Energy Program, "Alternative Financing–UESC," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/funding/uesc.asp>

Army Energy Program, "Appropriated Funds–ECIP," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/funding/ecip.asp>

Army Energy Program, "Appropriated Funds–MCA," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/funding/mca.asp>

Army Energy Program, "Army Energy and Water Management Program," updated January 4, 2010. As of March 31, 2011:

<http://army-energy.hqda.pentagon.mil/>

Army Energy Program, "Army Metering Implementation Plan," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/programs/metering.asp>

Army Energy Program, "Army Vision for Net Zero." As of May 4, 2011:

<http://army-energy.hqda.pentagon.mil/netzero/>

Army Energy Program, "EACA & EEAP." As of February 12, 2009:

<http://army-energy.hqda.pentagon.mil/training/seminars.asp>

Army Energy Program, "Energy Success Stories—Fort Campbell Natural Gas Engine Driven Chillers," updated January 4, 2010. As of March 13, 2010:

http://army-energy.hqda.pentagon.mil/archive/ess_campbell.asp

Army Energy Program, "Long-Range Energy Management Plans," updated January 4, 2010. As of March 14, 2010:

<http://army-energy.hqda.pentagon.mil/programs/plans.asp>

Army Energy Program, "Other Funding Sources," updated January 4, 2010. As of March 14, 2010: <http://army-energy.hqda.pentagon.mil/funding/other.asp>

Bauman, N. N., et al., "HVAC Retuning Report for Selected Facilities of Fort Carson, Colorado," Battelle—Pacific Northwest Division, Richland, Washington, February 2004.

Bromberg, MG Howard B., "Fort Bliss Energy Program," AUSA presentation, October 6, 2009.

Brown, D. R., et al., "Fort Campbell Kentucky Final FEDS Assessment and 10-Year Energy Plan," Pacific Northwest National Laboratory, April 2, 2004.

Building Operator Certification, "Ft. Lewis Army Base, Ft. Lewis, Washington," undated. As of March 17, 2010: http://www.theboc.info/w-success-stories/FtLewis_Case_Study_Final.pdf

California Energy Commission, "Consumer Energy Center," 2007. As of March 14, 2010: <http://www.consumerenergycenter.org/erprebate/index.html>

Chvala, W. D., et al., "Renewable Energy Opportunities at Fort Carson, Colorado," PNNL, U.S. DOE, PNNL-18132, December 2008.

Chvala, W. D., et al., "Renewable Energy Opportunities at Fort Bliss, Texas," PNNL, U.S. DOE, PNNL-18169, January 2009.

Coleman, Phil, Lawrence Berkeley National Laboratory, "Demand Response in the U.S.—Key Trends and Federal Facility Participation," *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

Congressional Research Service, "Energy Policy Act of 2005: Summary and Analysis of Enacted Provisions," CRS Report for Congress, The Library of Congress, March 8, 2006.

Defense Science Board, *More Fight—Less Fuel*, Defense Science Board Task Force on DoD Energy Security, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, Washington, D.C., February 2008.

Department of Energy, Energy Information Administration (DOE/EIA), "Electric Power Industry Overview 2007." As of September 19, 2011: <http://www.eia.doe.gov/cneaf/electricity/page/prim2/toc2.html>

Department of the Army, "Fiscal Year 2004 Secretary of Defense Environmental Awards Nomination: Pollution Prevention (Installation) Fort Campbell, KY," 2005.

Department of the Army, "The U.S. Army Energy and Water Campaign Plan for Installations: Fiscal Year 2008–Fiscal Year 2013," August 1, 2006.

Department of the Army, "The U.S. Army Energy and Water Campaign Plan for Installations: The Army's 25 Year Plan in Support of POM FY2010–2015," December 1, 2007. As of March 14, 2010: <http://army-energy.hqda.pentagon.mil/programs/plan.asp>

Department of the Army, "Department of the Army Policy Guidance for Implementation of a Utility Energy Services Contract," draft, January 2009.

Department of the Army, "Army Energy Security Implementation Strategy," January 13, 2009.

Department of the Army, OASA (Installations, Energy and Environment), "Sustainable Design and Development Policy Update (Environmental and Energy Performance)," Washington, D.C., October 27, 2010.

Duttweiler, Jim, "Fort Campbell Sustainability Program Update," briefing, DPW, Fort Campbell, Kentucky, June 20, 2007.

Energy Information Administration (EIA), *Annual Energy Outlook* (AEO) 2009.

Energy Information Administration (EIA), *International Energy Outlook* (IEO), 2009.

Executive Office of the President of the United States, “Executive Order 13423: Strengthening Federal Environmental, Energy, and Transportation Management,” January 26, 2007.

Executive Office of the President of the United States, “Federal Leadership in Environmental, Energy, and Economic Performance,” Executive Order 13514, October 2009.

Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia, FUPWG Fall 2008 Report, Fall 2008.

FEMP, “Case Study: Fort Lewis Army Base,” U.S. DOE, undated. As of February 19, 2009:
http://www.theboc.info/w-success-stories/FtLewis_Case_Study_Final.pdf

FEMP, “Federal Energy and Water Management Awards,” U.S. DOE, undated. As of March 17, 2010:
http://www1.eere.energy.gov/femp/services/awards_fewm.html

FEMP, “Utility Energy Services Contracts Lessons Learned: Negotiating Financing,” U.S. DOE, undated.

FEMP, “Utility Energy Services Contracts: Enabling Documents,” U.S. DOE, DOE/GO-102000-1111, Revised October 2001. As of March 14, 2010:
<http://www1.eere.energy.gov/femp/pdfs/28792.pdf>

FEMP, “Fort Knox Strikes Energy-Savings Gold in Innovative UESC Partnership,” *FEMP Focus*, May/June 2002.

FEMP, “Financing Mechanisms: Case Study—Fort Knox Strikes Energy-Savings Gold in Partnership with Utility,” July 2002. As of August 18, 2011:
http://www1.eere.energy.gov/femp/financing/uescs_csknox.html

FEMP, “Total-Solutions Approach at White Sands Missile Range,” Utility Services Case Study fact sheet, July 2002. As of February 14, 2010:
http://www1.eere.energy.gov/femp/pdfs/uesc_cs_5.pdf

FEMP, “Fort Lewis Benefits from Building Operator Certification Training,” March 21, 2005. As of March 17, 2010:
http://www1.eere.energy.gov/femp/news/news_detail.html?news_id=8954

FEMP, “2003 Federal Energy and Water Management Award Winners,” U.S. Department of Energy, updated March 6, 2006. As of March 13, 2010:
http://www1.eere.energy.gov/femp/services/awards_fewm2003.html#energyorg

FEMP, “2006 Federal Energy and Water Management Award Winners,” November 19, 2006. As of March 13, 2010:
http://www1.eere.energy.gov/femp/services/awards_fewm2006.html#renewgrp

FEMP, “2007 Federal Energy and Water Management Award Winners,” U.S. DOE, November 6, 2007. As of February 12, 2010:
http://www1.eere.energy.gov/femp/services/awards_fewm2007.html

FEMP, “M&V Guidelines: Measurement and Verification for Federal Energy Projects, Version 3.0,” U.S. DOE, April 2008.

FEMP, “Financing Mechanisms: Energy Savings Performance Contracts,” updated September 3, 2009. As of March 14, 2010:
<http://www1.eere.energy.gov/femp/financing/espcs.html>

FEMP, "About the Program: Energy Management at Federal Facilities," updated October 8, 2009. As of March 14, 2010:

<http://www1.eere.energy.gov/femp/about/emff.html>

FEMP, "Financing Mechanisms: Types of Utility Energy Service Contracts," updated October 28, 2009. As of March 15, 2010:

http://www1.eere.energy.gov/femp/financing/uescs_types.html

FEMP, "Financing Mechanisms: Utility Energy Services Contracts," updated October 28, 2009. As of March 14, 2010:

<http://www1.eere.energy.gov/femp/financing/uescs.html>

FEMP, "Financing Mechanisms: Power Purchase Agreements," updated February 3, 2010. As of March 14, 2010:

http://www1.eere.energy.gov/femp/financing/power_purchase_agreements.html

FEMP, "Program Areas: Operations and Maintenance," U.S. DOE, updated February 16, 2010. As of March 14, 2010:

http://www1.eere.energy.gov/femp/program/operations_maintenance.html

Fort Campbell, *Fort Campbell Strategic Plan 2007–2012*, Fort Campbell, Kentucky, 2007.

Fort Campbell, *Installation Strategic Plan: Sustainability Program Annex, Implementation Plan, 2007–2012*, Fort Campbell, Kentucky, 2007.

Fort Carson, "Fort Carson Sustainability Baseline," Fort Carson, Colorado, August 2002.

Fort Carson, "Fort Carson 2005 Sustainability Progress Report," Fort Carson, Colorado, 2005.

Fort Carson, "Fort Carson 2006 Sustainability Report," Fort Carson, Colorado, 2006.

Fort Carson, "Fort Carson 2007 Sustainability Report," Fort Carson, Colorado, 2007.

Fort Carson, "Supplemental Information: 30th Annual Secretary of the Army Energy and Water Management Awards: FY07 Accomplishments for Fort Carson," 2008.

Fort Carson, "Fort Carson Recipient of Governor's Excellence in Renewable Energy Award," news release, Public Affairs Office, Fort Carson, Colorado, January 11, 2008.

Fort Carson, "Sustainability Program Home Page," U.S. Army Environmental Compliance Division, Fort Carson, Colorado, last modified on February 28, 2008. As of March 13, 2010:

http://sems.carson.army.mil/sustainability/sustainability_program_home_page_default.htm

Fort Carson, "Energy Management Plan (EMP), Fort Carson, CO," Fort Carson, Colorado, September 2008.

Fort Knox, "Long-Range Energy Management Plan: Fort Knox, KY," Fort Knox, Kentucky, March 28, 2005.

Fort Lewis, "Fort Lewis Executive Summary Five Year Plan: Sustainability Implementation Plan," Fort Lewis, Washington, undated.

Fort Lewis, "The Sustainable Interiors Showroom (factsheet)," Fort Lewis, Washington, undated.

Fort Lewis, "Fort Lewis Executive Summary, Five Year Plan: Sustainability Implementation Plan," Fort Lewis, Washington, 2003(a).

Fort Lewis, "Fort Lewis Sustainability Annual Report April 2003," Fort Lewis, Washington, 2003(b).

Fort Lewis, "Sustainability Annual Report April 2003," Fort Lewis, Washington, 2003(c).

Fort Lewis, "Sustainable Fort Lewis: Progress Report for April 2003–April 2004," Fort Lewis, Washington, 2004.

Fort Lewis, "Sustainable Fort Lewis: April 2004–April 2005 Progress Report," Fort Lewis, Washington, 2005.

Fort Lewis, "Sustainable Fort Lewis: 2005–2006 Annual Report," Fort Lewis, Washington, 2006.

Galentine, Susan C., "Army's Largest Solar Array Finds Home on Former Landfill Site," Directorate of Public Works Environmental Division, Fort Carson, Colorado, undated.

GAO, "Capital Financing: Partnerships and Energy Savings Performance Contracts Raise Budgeting and Monitoring Concerns," GAO-05-55, December 2004.

GAO, "Energy Savings: Performance Contracts Offer Benefits, but Vigilance Is Needed to Protect Government Interests," GAO-05-340, June 2005.

Hadekel, Peter, "Green Building Movement Is Growing Some Legs," *The Gazette*, Montreal, April 6, 2007.

Hall, Kristin, "'Zero-energy' Pilot Homes Planned at Fort Campbell," Associated Press, August 27, 2008.

Harris, R., "LEED Takes Hold at Fort Bragg," *Public Works Digest*, May/June 2007.

"A Hero Behind the Scenes," *NOLIN News: Kentucky Living*, Elizabethtown, Kentucky, December 2006.

IMCOM, "The Installation Management Campaign Plan 2010–2017," Version 3.0, April 2011.

Joint Base Lewis-McChord website. As of February 18, 2009:
<http://info.lewis-mcchord.army.mil/index.htm>

Joint Base Lewis-McChord, "Sustainable Joint Base Lewis-McChord, WA: Sustainable Goals," updated February 2, 2009. As of March 17, 2010:
<https://sustainablefortlewis.army.mil/Goals.asp>

Joint Base Lewis-McChord, "About Us," Joint Base Lewis-McChord, Washington, updated February 19, 2010. As of March 17, 2010:
<http://info.lewis-mcchord.army.mil/about.htm>

Joint Base Lewis-McChord, "Lewis-McChord Joint Basing," last updated February 19, 2010. As of March 13, 2010:
<http://info.lewis-mcchord.army.mil/>

Kats, Greg, "The Costs and Financial Benefits of Green Buildings," October 2003. As of July 2011:
<http://www.usgbc.org/Docs/News/News477.pdf>

Kidd, Richard, FEMP, Department of Energy, "Comments," *Federal Utility Partnership Working Group (FUPWG) Meeting, November 19–20, 2008, Williamsburg, Virginia*, FUPWG Fall 2008 Report, Fall 2008.

Lachman, Beth E., Ellen M. Pint, Gary Cecchine, and Kimberly Colloton, *Developing Headquarters Guidance for Army Installations Sustainability Plans in 2007*, Santa Monica, California: RAND Corporation, MG-837-A, 2009.
<http://www.rand.org/pubs/monographs/MG837.html>

Macintire, Jerrie, "Campbell Departments Sweep Competition," *The Fort Campbell Courier*, Vol. 44, No. 50, December 2008.

McAndrew, David, "Utility Energy Services Contracting Overview," briefing, FEMP, 2006.

Mills, Evan, *Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions*, Report, Lawrence Berkeley National Laboratory, July 21, 2009. As of August 18, 2011: <http://cx.lbl.gov/2009-assessment.html>

Mills, Evan, and Paul Matthews, *Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects*, LBNL-1972E, Lawrence Berkeley National Laboratory, June 2009.

The National Training Center and Fort Irwin, "Welcome to the Fort Irwin, California Enhanced Use Leasing (EUL) Web Site," updated July 30, 2009. As of March 14, 2010: <http://eul.army.mil/ftirwin/>

North Carolina State University, North Carolina Solar Center, "DSIRE: Database of State Incentives for Renewables and Efficiency," 2009. As of March 14, 2010: <http://www.dsireusa.org/>

OASA (Installations, Energy and Environment), "Net Zero Installations Identified," no date. As of May 9, 2011: <http://www.asaie.army.mil/Public/IE/>

Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, *Energy Security Tiger Team Assessment—Fort Bliss, Final Report*, Washington, D.C., April 14, 2009.

OSD, "Energy Savings Performance Contracts and Utility Energy Savings Contracts," OSD Memorandum, January 24, 2008.

Silberglitt, Richard, Anny Wong, S. R. Bohandy, Brian G. Chow, Noreen Clancy, Scott Hassell, David R. Howell, Gregory S. Jones, Eric Landree, and Parry Norling, *The Global Technology Revolution China, Executive Summary: Emerging Technology Opportunities for the Tianjin Binhai New Area (TBNA) and the Tianjin Economic-Technological Development Area (TEDA)*, Santa Monica, Calif.: RAND Corporation, MG-776-TBNA/TEDA, 2009. <http://www.rand.org/pubs/monographs/MG776.html>

Smidt, Randy, "Army Policy Guidance for Utility Energy Services Contracts," presented at the Federal Utility Partnership Working Group, May 5, 2009. As of September 13, 2011: http://www1.eere.energy.gov/femp/pdfs/fupwg_spring09_smidt.pdf

Smidt, Randy, and Amy Solana, "Army Policy Guidance for Utility Energy Services Contracts," presented at the Federal Environmental Symposium, Bellevue, Washington, June 2–4, 2009. As of March 31, 2011: http://www.fedcenter.gov/_kd/go.cfm?destination=ShowItem&Item_ID=12490

Smith, Dewayne, "Lessons Learned: Utility Energy Services Contracts," briefing, IMCOM/Southeast Region Energy Managers Forum, Atlanta, Georgia, February 13, 2008.

Smith, Megan, "Fort Campbell Plans First Zero-Energy Homes in Army," *The Fort Campbell Courier*, Fall 2008.

Smith, Megan, "Massive Construction Underway," *The Fort Campbell Courier*, Vol. 44, No. 50, December 11, 2008.

Snook, Jim, Steve Dumont, and Mike Warwick, "Power Purchase Agreements for Renewable Energy," PowerPoint presentation at GovEnergy, Phoenix, Arizona, August 3–6, 2008.

SolarWall.com, "Solar Air Heating and Ventilation with SolarWall Systems." As of March 17, 2010: <http://solarwall.com/en/products/solarwall-air-heating.php>

Southern California Edison, "Builder and Buyer: Savings by Design." As of March 17, 2011: <http://www.sce.com/b-rs/bb/savings-by-design.htm>

Southern California Edison, "Energy Centers," 2010. As of August 18, 2011:
<http://www.sce.com/b-sb/energy-centers/>

State of California, California Energy Commission, "Go Solar California," undated. As of March 14, 2010:
<http://www.gosolarcalifornia.ca.gov/>

Steven Winter Associates, "GSA LEED Cost Study," October 2004. As of July 2011:
<http://www.wbdg.org/ccb/GSAMAN/gsaleed.pdf>

Underwood, David M., et al., "Energy Optimization Assessment at U.S. Army Installations: Fort Bliss, Texas," CERL, USACE, Champaign, Illinois, September 2008.

U.S. Army, "Army Regulation 420-41, Acquisition and Sales of Utilities Services," Washington, D.C., Headquarters, Department of the Army, September 15, 1990.

U.S. Army, "The Army Strategy for the Environment: Sustain the Mission—Secure the Future." Washington, D.C., U.S. Army Environmental Policy Institute, 2004.

U.S. Army, "The US Army Energy Strategy for Installations," July 8, 2005. As of March 13, 2010:
<http://army-energy.hqda.pentagon.mil/docs/strategy.pdf>

U.S. Army, "Army Regulation 200-1, Environmental Protection and Enhancement," Washington, D.C., Headquarters, Department of the Army, December 13, 2007.

U.S. Army, "30th Annual Secretary of the Army Energy and Water Management Award: In Recognition of Accomplishments during Fiscal Year 2007," Award Summary, 2008. As of September 19, 2011:
http://army-energy.hqda.pentagon.mil/docs/30th_sa_award_summaries.pdf

U.S. Army, "Army Regulation 420-1, Army Facilities Management," Washington, D.C., Headquarters, Department of the Army, March 28, 2009.

U.S. Army Corps of Engineers, "Enhanced Use Leasing: Official Web Site for the Army EUL Program," updated March 9, 2010. As of March 14, 2010:
<http://eul.army.mil/>

U.S. Army Installation Management Command Western Region, "Public Works Joint Base Lewis-McChord, WA," updated February 2, 2010. As of March 13, 2010:
<http://www.lewis.army.mil/publicworks/>

U.S. Department of Energy (DOE), "Commissioning for Federal Facilities: A Practical Guide to Building Commission, Recommissioning, Retrocommissioning, and Continuous Commissioning," undated.

U.S. Department of Energy (DOE), Energy Information Administration (DOE/EIA), "Electric Power Industry Overview 2007," undated. As of August 18, 2011:
<http://www.eia.doe.gov/cneaf/electricity/page/prim2/toc2.html>

U.S. Department of Energy (DOE), "Fort Lewis Army Base," *Building America Best Practices Series: Volume 5—Builders and Buyers Handbook for Improving New Home Efficiency, Comfort, and Durability in the Marine Climate*, February 2006. As of September 19, 2011:
http://www.energy.wsu.edu/ftp-ep/pubs/building/project/FtLewis_Feb06.pdf

U.S. Department of Energy (DOE)/EERE, "States with Renewable Portfolio Standards," updated June 16, 2009. As of March 14, 2010:
http://www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm#chart

U.S. EPA, "The Guide to Purchasing Green Power: Renewable Electricity, Renewable Energy Certificates and On-Site Renewable Generation," September 2004.

U.S. Green Building Council, "LEED for New Construction," 2010. As of January 23, 2010:
<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220#v2.2>

U.S. Library of Congress (U.S. LOC), "H.R.6, Energy Policy Act of 2005," 2005. As of March 13, 2010:
<http://thomas.loc.gov/cgi-bin/bdquery/z?d109:HR00006>:

U.S. Library of Congress (U.S. LOC), "H.R.6, Energy Independence and Security Act of 2007," 2007. As of March 13, 2010:
<http://thomas.loc.gov/cgi-bin/bdquery/z?d110:h.r.00006>:

Washington State University Energy Program, "Fort Lewis Army Base." As of February 19, 2009:
http://www.energy.wsu.edu/ftp-ep/pubs/building/project/FtLewis_Feb06.pdf

Westervelt, Eileen T., and Donald F. Fournier, *Energy Trends and Implications for U.S. Army Installations*, U.S. Army Corps of Engineers, Engineer Research and Development Center, September 2005.

Wiser, Ryan, and Mark Bolinger, "2008 Wind Technologies Market Report," U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, July 2009. As of September 19, 2011:
<http://eetd.lbl.gov/ea/ems/reports/2008-wind-technologies.pdf>